Proceedings and Transactions

OF THE

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE,

FOR

1871, 1872, 1873, 1874.

VOLUME III.

HALIFAX, NOVA SCOTIA:
WILLIAM GOSSIP, 87 GRANVILLE STREET.

ENGLAND:
REEVES & TURNER, 196 STRAND, LONDON.

UNITED STATES:
THE NATURALIST AGENCY, SALEM, MASS.

1874.

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PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. III. 1870-71. PART I.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 87 GRANVILLE ST.
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PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. III. PART I.

Institute Room, Province Building, Oct. 12th, 1870.

ANNIVERSARY MEETING.

J. M. JONES, ESQ., *President, in the Chair.*

Inter alia.

THE following were elected by ballot:—

President—J. M. JONES, ESQ., F. L. S.

Vice Presidents—PROF. G. LAWSON, Ph. D., L. L. D., BERNARD GILPIN, ESQ., M. D., M. R. C. S.

Honorary Secretary—W. GOSSIP, ESQ.

Treasurer—W. C. SILVER, ESQ.

Council—FRED. ALLISON, ESQ., J. R. DEWOLFE, ESQ., M. D., J. RUTHERFORD, ESQ. M. E., H. MOODY, ESQ., REV. D. HONEYMAN, D. C. L., F. G. S., &c., ANGUS ROSS, ESQ., P. S. HAMILTON, ESQ., JOS. BELL, ESQ.

ORDINARY MEETING, NOVEMBER 14, 1870.

J. M. JONES, *President, in the Chair,*

THE President called upon Dr. Honeyman, who read an introductory paper "*On the Geology of Nova Scotia,*" as far as he has been connected with it. (See Transactions.)

The President read a paper "*On the Lepidoptera of Nova Scotia,*" with especial reference to the neighbourhood of Halifax. The paper was illustrated with specimens. (See Transactions.)

The Rev. Moses Harvey, of St. John's, Newfoundland, was proposed as a corresponding member.

ORDINARY MEETING, DECEMBER 12, 1870.

BERNARD GILPIN, ESQ., M. D., *Vice President, in the Chair.*

The Secretary announced that the Council had duly elected the Rev. Moses Harvey, as a corresponding member, and the Rev. Professor Elder, of Acadia College, Wolfville, an associate member.

A paper "*On the Copper and Nickel Mines of Tilt Cove, Newfoundland,*' by Elias Marett, Esq. was read. (See Transactions.)

Also a paper "*On the Geology of Nova Scotia,*" by the Rev. D. Honeyman, D. C. L., F. G. S. (See Transactions.)

ORDINARY MEETING, JANUARY 9, 1871.

J. M. JONES, ESQ., *President, in the Chair.*

A paper "*On the Geology and Physical Geography of the North East coast of Kent, England,*" by Alfred S. Ford. (See Transactions.)

The paper was illustrated by a series of beautiful drawings and pen and ink sketches.

ORDINARY MEETING, FEBRUARY 13, 1871.

J. M. JONES, ESQ., *President, in the Chair.*

Rev. D. HONEYMAN read a paper "*On the Geology of the Pictou Coal Field*" which led to an interesting conversation, continued until a late hour. The paper was illustrated by a copy of a field map prepared for the geological survey of Canada by the author. (See Transactions.)

DR. GILPIN'S paper "*On the Mammals of Nova Scotia,*" was deferred until the next ordinary meeting. (See Transactions.)

ORDINARY MEETING, MARCH 13, 1871.

J. M. JONES, ESQ., *President, in the Chair.*

Dr. B. GILPIN, read a paper "*On the Mammals of Nova Scotia—The Caribou.*" The paper was illustrated by drawings and specimens of the horns of the animal in different stages of growth. (See Transactions.)

The President (J. M. JONES, ESQ.,) read a paper "*On the Diurnal Lepidoptera of Nova Scotia.*" The paper was illustrated by a beautiful collection of specimens. (See Transactions.)

Interesting conversations followed the reading of the above paper.

ORDINARY MEETING, APRIL 10, 1871.

J. M. JONES, ESQ., *President, in the Chair.*

DR. LAWSON read an interesting paper "*On Ranunculaceæ.*" The paper was illustrated by drawings and specimens. (See Transactions.)

ORDINARY MEETING, MAY 8, 1871.

J. M. JONES, ESQ., *President, in the Chair.*

A paper "*On the Meteorology of Glace Bay, Cape Breton,*" by H. POOLE. ESQ.; and a paper "*On the Meteorology of Halifax, in* 1870," by FRED. ALLISON, ESQ., were read by the latter author. (See Transactions.)

D. H.

DONATIONS TO THE INSTITUTE.

SEPT. 1, 1870, TO AUGUST 31, 1871.

Hon. Dr. Parker, M. L. C., N. S. $20.00

BOOKS.

American Academy of Sciences—Transactions. Vol. 17.

Walter Lawson, Esq., C. E., Montague Gold Mines.—Explanations and Surveys for a Railway from the Mississippi to the Pacific. Vols. 2, 3, 4, 5, 6, 7, 8, 9.

LIST OF MEMBERS.

Date of Admission.			
1869.	Feb.	15.	Allison, Augustus, Halifax.
1869.	Feb.	15.	Allison, Frederick, Halifax.
1863.	June	24.	Almon, Hon. M. B., Hollis Street, Halifax.
1864.	April	3.	Bell, Joseph, High Sheriff, Halifax.
1863.	Jan.	8.	Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
1864.	Nov.	7.	Brown, C. E., Granville Street, Halifax.
1867.	Sep.	20.	Cogswell, Dr., Dentist, Halifax.
1868.	Sep.	28.	Collins, Brenton, Halifax.
1871.	April	4.	Compton, William, Halifax.
1870.	Mar.	30.	Day, Forshaw, Artist, Halifax.
1869.	April	29.	Dakin, G. W., Halifax.
1863.	Oct.	26.	DeWolfe, James R., M. D., Edin., L. R. C. S. E., Halifax.
1863.	Dec.	7.	Downs, Andw., *Corr. Memb. Z. S.*, Dutch Village, Halifax.
1865.	Oct.	4.	Fleming, Sanford, C. E., *Chief Engineer af Railways*, Halifax.
1863.	Jan.	5.	Fraser, R. G., Mineralogist, Halifax.
1863.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., VICE PRESIDENT, Halifax.
1863.	Feb.	2.	Gossip, William, SECRETARY, Granville Street, Halifax.
1863.	Jan.	26	Haliburton, R. G., F. S. A., Halifax.
1863.	Jan.	5.	Hamilton, P. S., Barrister, Halifax.
1863.	June	27.	Hill, P. C., D. C. L., Halifax.
1866.	Dec.	3.	Honeyman, Rev. D., D. C. L., F. G. S., &c., *Director of the Provincial Museum*, Halifax.
1868.	Nov.	2.	Hudson, James, C.E, *Superintendent of the Albion Mines*, Pictou.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., PRESIDENT, Halifax.
1866.	Feb.	1.	Kelly, John, *Deputy Commissioner of Mines*, Halifax.
1867.	Jan.	7.	Knight, Thos. F., *Inspector of Customs*, Dartmouth.
1864.	March	7.	Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, VICE PRESIDENT, Dalhousie College, Halifax.
1865.	Sept.		Lordly, C. E., George Street, Halifax.
1869.	Dec.	30.	Moody, Harry, *Pri. Sec'y of His Honor the Lieut. Governor.*
1866.	Feb.	3.	Morrow, James B., Halifax.
1868.	Nov.	25.	Morley, Lieut. R. A.
1870.	Jan.	10.	Murphy, ——, C. E., Halifax.
1865.	Nov.	17.	Nash, J. D., Halifax.
1865.	Aug.	29.	NOVA SCOTIA, the Rt. Rev. Hibbert Binney, D.D., Lord Bishop of.
1863.	Jan.	5.	Poole, Henry, M. E., Glace Bay Mines, Cape Breton.
1870.	Jan.	20.	Power, L. G., Barrister, Halifax.
1866.	July	28.	Reeks, Henry, Manor Hall, Thruxton, Hamp., Eng.
1868.	Dec.	29.	Roue, Jno., Halifax.
1869.	June	27.	Ross, Angus, Halifax.

1866.	Jan.	8.	Rutherford, John, M. E. *Inspector of Mines*, Halifax.
1864.	March	7.	Silver, W. C., TREASURER, Halifax.
1868.	Nov.	25.	Sinclair, John A., Halifax.
1865.	April	20.	Smithers, Geo., Halifax.
1867.	Aug.	16.	Tobin, Stephen, Halifax.
1864.	May	16.	Whytal, Jno., Halifax.
1870.	Mar.	30.	Wesselhoft, Dr., Halifax.
1866	Mar.	18.	Young, *Sir* William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
1870.	Oct.	27.	Elder, Professor, Acadia College, Wolfville, N. S.
1868.	June	13.	Ford, Alfred S., London, G. B.
1864.	July	1.	Marett, Elias, St John's, Newfoundland.
1865.	Dec.	28.	Morton, Rev. John, Trinidad.

CORRESPONDING MEMBERS.

1868.	Nov.	25.	Berthune, Rev. J. S., Ont. Canada.
1866.	Sep.	29.	Chevalier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1870.	Oct.	27.	Harvey, Rev. Moses, St. John's, Newfoundland.
1866.	Feb.	5.	Hurdis, J. L., Southampton, England.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., N. S.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I. Record of Observations on Nova Scotian Geology, since 1855. By Rev. D. Honeyman, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

(*Read Nov.* 14, 1870.)

I now purpose to record the most important observations made by me since the year 1855. This is the date of the publication of the first edition of Dawson's *Acadian Geology*. To this classic work and the friendship and suggestions of its distinguished author, I am indebted for an introduction to the practical study of Nova Scotian Geology. I commenced by directing attention to the Geology of Arisaig, a locality and a township in the county of Antigonish. Antigonish was the place of my residence. I made the rocks of Arisaig a special study for several years. I have examined them with the greatest minuteness. The position and appearance of its rocks are familiar as the objects in my parlour; their fauna are my intimate acquaintances.

In my first communication "On the Geology of Arisaig," read before the Nova Scotia Literary and Scientific Society (the short-lived predecessor of this Institution), I shewed from the character of a large collection of fossils made in what was then considered to be the upper rocks of the Arisaig series, and what are now designated the *Upper Arisaig* (vide *Acadian Geology* last edition) that the rocks are not Devonian as was then supposed, but the equivalents of the Upper Ludlow of England, and therefore Upper Silurian. While my paper was in the press Dr. Dawson informed me by letter, that he considered the rocks in question as probably the equivalents of the Lower Helderberg of the United States, and therefore Upper Silurian. Prof. Hall subsequently, and afterward

Mr. Salter, on examining my collections in the Exhibition of 1862, confirmed this opinion, so that this is now an article in the Nova Scotian Geological Creed.

Prof. Hall and Dr. Dawson then distinguished a lower member of the same series. One of the characteristic fossils of this member is Graptolithus Clintonensis; it is therefore considered to be the equivalent of the Clinton of the United States or Middle Silurian. This is designated by Dr. Dawson (vide *Acadian Geology* last ed.) the *Lower Arisaig*. I found in Arisaig rocks, intermediate between these two members, strata having a distinct fauna, *i. e.*, different from those of the equivalents of the Upper Ludlow or Lower Helderberg and the Clinton.

Mr. Salter on examining my collections pronounced them to be Aymestry limestone fossils. This band may therefore be considered as the probable equivalent of the Niagara Limestone. At Doctor's Brook of Arisaig, and in the township of Arisaig, are shales which appear lithologically distinct from the Clinton or Lower Arisaig of Dawson, and were supposed to be non-fossiliferous. In them I found fossils which however did not appear to be characteristic of distinctive. They were considered to be lower than the Clinton or Arisaig, as undoubtedly the strata were lower in position, and that was all that could be said about them. In the meantime I discovered a band of fossiliferous rocks to the east of Lochaber Lake in the county of Antigonishe. In the upper part of the band or those on the margin of the Lake, I found characteristic fossils of upper Arisaig, *e. g.* Chonetes Nova Scotica, Hall. I found many others of the same age, but not *in situ*, e. g. *Dalmania Logani*, *Crania Acadiensis*. Farther back I found strata with casts of *Petraia Forresteri* and of *Trumpet shaped Cornulites*, (Salter thus characterised them,) which evidently occupied stratagraphically a lower position than the upper Arisaig, although the fossils were by some supposed to be Devonian. Mr. Salter considered the fossils to be equivalents of the May Hill sandstone. Subsequently I found Aymestry Limestone fossils in the same locality, showing that the Middle Arisaig also existed here. I also, about the same time, discovered another fossiliferous locality in Merigomish, County of Pictou, where branches of French River intersect the New Glasgow

Road. I found strata with *Graptolithus Clintonenses* and other Graptolites, Trilobites, Strophomena, Orthis, &c. In the drift near Sutherland's River I found abundance of upper Arisaig fossils. shewing the existence of upper Arisaig strata in this quarter. While making these discoveries I had also been developing the Silurian of Springville, East River, Pictou. Having occasion to visit this place annually I had become somewhat familiar with its prominent features. It was, however, at the time of the Prince of Wales' visit to Nova Scotia that I made decided progress in the investigation of the details of the locality. I then made a special visit to Springville with a view to a particular investigation.

My worthy mare Jess, my associate in my distant Geological rambles, apparently resolving that I should keep to work, took a ramble herself, and left me for a month to pursue my geological investigations alone. I then discovered an interesting fauna in the upper part of the series generically and specifically identical with the Upper Arisaig. These were found immediately underlying the carboniferous at McLean's and MacIntosh's. I found as at Arisaig, Ascoceras, Orthoceras, Theca, Bellerophon, different species, Murchisonia, Avicula Honeymani, abundant, Modiolopsis, Clidophorus, Spirifer subsulcatus, Chonetes Nova Scotica, Crania Acadiensis, Rhynchonella, various, Homalonotus Dawsoni, Dalmania Logani, Prœtus Stokesi, Calymene, Leperditia, Beyrichia, Favosites. One prominent stratum shewed exactly the same association of organisms as at Arisaig, viz: Homalonotus Dawsoni, in abundance, with abundance of Spirifer subsulcatus, Avicula Honeymani, and Cornulites. The only obvious distinction is, that the East River stratum shews a higher degree of metamorphism than the stratum at Arisaig. At the North of the late Rev. Angus McGillivray's I found the Arisaig Niagara equivalent fossils. This ridge extends up the river about a mile. The same farther south produced a large Orthoceras, Strophemena profunda, Spirifer Crispus, Atrypa reticularis, Rhynchonella didyma, Rhynchonella varia, Calymene and Homalonotus, of species as in the same horizon at Arisaig. I also found a lower band in a mountain in the rear with singular Discina, Lingula and Homalonotus, different from these of the higher members. This appeared to be of Lower Arisaig age, *Dawson*.

I found in Lime Brook a cast of Petraia such as at Lochaber, not *in situ*, shewing the existence of lower Lochaber strata in this locality. At the same time I found in the shales and limestones of lower carboniferous age below Grant's Factory, East Branch East River, teeth of Cochliodus and Bellerophon decussatus, according to Salter. This was the first discovery of Bellerophon, in the lower carboniferous limestones of Nova Scotia.

While making the observations that I have recorded, I discovered teeth of Diplodus acinaces, *Dawson*, at least cotemporaneous with the discovery by Mr. Poole at the coal mine near New Glasgow, at the side of the road to Antigonishe. I described them in the first vol. of the Journal of Education as reptilian. I found a large tooth of Rhizodus at the Joggins, and discovered and measured the carboniferous section on the shore north of Mabou Harbor.

I may mention still farther that I found Lochaber Petraia in boulders in the bed of French River, below the Presbyterian Church, shewing the existence of Lochaber Petraia strata in this region, and also Petraia and Lingula *in situ* in strata on the main road in the Marshy Hope on the Pictou and Antigonishe county line, and at MacDougall's to the east of it, *i. e.* nearly *due south* of Arisaig. About the same time I discovered part of the singular Lingala bed near Barney's River.

These observations recorded are the more prominent results of *amateur* work, through which was accumulated the greater part of these collections which interested Murchison, Philips, Bigsby, Salter, Barrande, DeVerneuil, &c., and received Prize Medals in the Exhibitions of London, 1862, Dublin, 1865, and Paris, 1867. In August, 1861, I was engaged by the Nova Scotia Commission for the London Exhibition of 1862, to make a representation of the Geology and mineral resources of Nova Scotia. In prosecuting this work I visited Cape Breton and added to the Geological Map the Gypsums of West Bay in the vicinity of the Rev. Murdoch Stewart's, a beautiful carboniferous section with abundance of regularly formed clay ironstone septaria, which attracted some attention at the London Exhibition. This is situated in a brook a few miles toward St. Peter's Canal. I sailed over the Bay and found the so-called Marble Mountain, which has lately been brought into prominent notice by the enterprise of Mr. Brown. I visited Grand River, and found lower carboniferous limestones and a bed of wad or bog manganese, which had been supposed to be coal. I crossed over to Red Islands and collected a number of fossils. The most remarkable of them is a recurved Conularia. At Big Baddeck I found a mountain to consist of granite where I had expected to find syenite or greenstone, which led me subsequently to maintain that the Middle River or Wagamatcook auriferous strata were of the same age as the Nova Scotian strata, or Lower Silurian, and not Devonian as some Geologists maintained. I found marble at the head of Whycocomagh Lake, and the little carpolite shortly after described by Dr. Dawson in the Transactions of the Geological Society as Trigonocarpum *Hookeri*. I found this in a piece of sandstone on the shores of Port Hood. I returned to Nova Scotia and was directed by the Commission to give some attention to the Geology of the Gold Fields. I accordingly made an examination of the undeveloped Waverley barrel quartz. I examined the section of rocks on the Windsor and Truro lines of Railway, but not having time to make a detailed examination, my observations were necessarily crude. I communicated a paper on the subject to the Geological Society. In this paper I maintained the same view in regard to the Lower Silurian age of the gold fields as Dr. Dawson had done in his *Acadian Geology*. I may mention that in the discussion that took place in the Society on the reading of that paper, there was a difference of opinion expressed in regard to the age of the Gold Fields. Sir W. Logan impugned my views, maintaining that the rocks were *Devonian*. Sir Rodrick Murchison on the contrary, supported the views that I maintained. I found subsequently that my observations were too hastily made to be altogether accurate. The description of the field itself seems accurate enough, and the succession of the rocks between Lakelands and Windsor, but the order of rocks from Lakelands to Waverley, and the supposed connection of the rocks and the line with the Waverley Gold Field, was altogether imaginary.

After my return from the Exhibition, in the Autumn of 1863, I proceeded to examine the rocks of Arisaig with the aid of the new light furnished by Mr. Salter's report, and the suggestions of other eminent British and Continental Geologists and Palæontologists. I pitched my tent among the rocks and remained among them for nearly three months. I investigated thoroughly the nature and relations of the different parts of the series, studied thoroughly its palæontology, added materially to my collections of its fauna, and endeavoured to ascertain the range of the several families, genera, and species, in time.

I communicated the results to the Geological Society in a paper with map and sections, to be found in the Journal of 1864. It is with some satisfaction that I have now to add that after the lapse of seven years and after having made at least one other thorough examination of the district, I still regard this paper as a reliable handbook with which to examine Arisaig. I may have something to add to the observations then recorded, but very little to correct. At that time I discovered a bed of Graptolites at Doctor's Brook, in the black shales underlying the Clinton strata of Arisaig. These Graptolites include various diprionidean forms which appear more to resemble the Hudson River Graptolites than the Clinton. I extended these shales to McDonald's cove to the westward, where I found Cone-in-cone concretions and Lingula in nodules like my Barney's River Lingula bed, and thence to Arisaig cove to the south of the pier and the north-east of the strata, with Graptolites Clintonensis. I did not then find in the band an extensive fauna, and was led to infer that the conditions under which the shales were deposited were not favorable to animal existence.

This is an inference that I have since been led to modify. At this time I discovered the noble Cephalopoda of Middle Arisaig, or the Niagara limestone equivalent, and I also discovered at Doctor's Brook the equivalent of the Lochaber Petraia strata. By this discovery I was enabled to ascertain the exact position of those strata in the system, to make a larger collection of fossils than it was possible to make at Lochaber or Marshy Hope, and to ascertain the mode and order of their occurrence. In my paper I styled this A Arisaig—Doctor's Brook, McDonald's cove and to the S. of the Frenchman's barn (rock). I also found connected with this, another band (metamorphic) which I then supposed to be a part of the same but altered. I am now, however, disposed to separate them. I will return to this point again.

In the summer of 1864, I was engaged by the Government to make a preliminary Geological survey. I then ascertained the extent and distribution of the Silurian fossiliferous strata at Lochaber and the strata which appear to be succeeding these, which I am disposed to consider as Middle Silurian. I also extended the Lingula bed or the equivalent of the Doctor's Brook shales at Barney's River, extending it to the Middle branch. I also found the Lochaber Petraia rocks underlying the shales containing this bed and forming the side of the mountain range which extends to the east and west of the outcrop discovered, onward as I believe on the one side and the other to Marshy Hope and French River, main branch. Here the fossils appear to be as various and numerous as on the Arisaig shore. At the western entrance to the Marshy Hope with conglomerate in enormous mass intervening between it and the extension of the Lochaber equivalent just referred to, I found an outcrop of similar strata, which appear to be a continuation of those already referred to as occurring in Marshy Hope near the County line. I also directed attention to the east branch of East River, Pictou, and determined the Geological position of the bed of Iron ore there.

In 1866 I communicated to the Institute a paper on the Geology of Antigonish, which contains an account of what I had done in that County up to the time when it was written, and the opinions entertained in connection with the facts ascertained, *vide* paper in vol. I, part 4. I also made an examination of the Geology of the Londonderry Mines, and of the Gay's River Gold Field, *vide* Transactions of Institute, vol. I, part 1. In the Spring of 1868, I was engaged by Sir W. Logan in connection with the Canadian survey. The work prescribed to me was the collection of a suite of specimens from the Arisaig rocks, and the tracing of these rocks onward to the Cobequid Mountains.

In the performance of this work I was fortunate to make some interesting discoveries, one of which has excited some attention and discussion.

First of all I found in the section of Doctor's Brook shale in the

Arisaig cove, all the organisms that I found originally at Doctor's Brook in great number and in a better state of preservation, with corals of species different from any heretofore found in the Nova Scotian rocks, abundance of crinoids and trizobites of genera Phacops, and Calymene, in fine preservation, and Graptolites. This discovery shewed that the strata which I had before described as poor in fossils was on the contrary rather rich, and that the circumstances under which these shales originated were favorable to the existence of animal life.

In the succeeding strata or the Lower Arisaig of Dawson or Clinton equivalent, I found two specimens of Conularia. I had found the same organism in the same horizon at French River. These are the only instances in which this pteropod has been found in a position lower than the lower carboniferous in Nova Scotia. I would here observe that Dana in his list of foreign Silurian fossils not yet met with in America, specifies the *Grammysia cingulata*. By referring to my catalogue of the fossils found in the Arisaig Clinton, it will be there observed. Salter recognized it in my collection of the London Exhibition of 1862. I also succeeded in extending the Lower Arisaig farther to the east of Doctor's Brook, *i. e.* to the mouth of McNeil's brook, any farther extension of these in this direction must pass into the Strait of Northumberland.

In the beautiful section of the Arisaig rocks on the shore, a little to the east of McAra's Brook, there appears a set of red strata dipping in a different direction from the variegated strata or Lower Helderberg. As far as I can ascertain this red band of argillites is non-fossiliferous. I found these strata dipping regularly in McAra's Brook and beyond it, and therefore of considerable thickness. They are also found in McAdams' Brook to the east of McAras' Brook. They are certainly not Lower Helderberg and may therefore be Devonian. I would name them the McAra's Brook strata. Upon these the Lower Carboniferous conglomerates lie unconformably—the line of junction being behind a mass of amygdaloid. In my paper on Arisaig, I designated the Doctor's Brook Graptolite, and Lingula Shales B, and Dawson's Lower Arisaig B with an *accent*. There is a marked difference between the two sets of strata in structure. At the mouth of Arisaig

Brook is their place of meeting, and I thought to make this also the point of geological separation, but fortunately I found a nodule with a distinct Graptolithus Clintonensis on the shaley side of the line; so if this is to be regarded as a distinctive Fossil, Doctor's Brook shale is also a lower part of Lower Arisaig, and is also Clinton. The Petraia slates at Doctor's Brook are lithologically and palæontologically distinct from the shales. They were considered by Salter to be the equivalents of the May Hill sandstone of Great Britain. There is every probability that they are the equivalents of the Medina sandstone of the United States. Underlying these is a metamorphic band—until lately I have regarded this as a portion of what I have designated the Medina sandstone equivalent. I now regard it as the equivalent of the Oneida conglomerate, U. S. This includes the red Jaspideous rock of the Arisaig Pier and the Frenchman's Barn (rock) a considerable mass of rocks at Doctor's Brook, and similar rocks to the west of McNeil's Brook on the shore. Connected with these in the last mentioned locality, I discovered a soft variegated rock which strikingly contrasts with the hard unyielding character of its associate. It is easily polished, and may be useful for ornamental purposes. At first I regarded it as Steatite, and then Rensellærite. It is now considered to be a silicate of alumina—agalmatolite. I subsequently found it also in the same connection at Arisaig Pier, and it was afterwards found near Frenchman's Barn. In this locality there are veins of it, yellowish and translucent. Here it has since been quarried to some extent by a company formed for the purpose. It is reported to be serviceable for pottery. These rocks are considered to have been altered by the great dyke of greenstone, greenstone porphyry and amygdaloid, which is in contact with it throughout the entire length of the band.

It may tend to confirm my view of its equivalency if I quote the views of Dr. Dawson in reference to the character of the rocks in question: "It is a very instructive study to compare the soft conglomerates and their interstratified trap at McAra's Brook, *with the continuation of the same body eastward of Arisaig Pier* where they appear forced into hard quartzose rocks, in some of which the original texture is entirely obliterated." (*Acadian Geology*, 1*st ed. page* 268.)

The only difference is that formerly the rocks were regarded as altered Lower Carboniferous conglomerate, now they are regarded as altered Oneida conglomerate.

This fine series of Middle Silurian, Upper Silurian and Devonian strata exposed on the shore dip, in a general southerly direction; exposed in and near Arisaig Brook, Doctor's Brook, and McNeil's Brook are similar strata; at least one of the middle members of the series is found dipping in a general northerly direction. The two thus form a synclinal. On the east branch of Doctor's Brook, and a small southern tributary is an insulated patch of Lower Carboniferous strata consisting of a considerable band of limestone, underlaid by conglomerate greenstone and porphyry. I have characterised it as insulated. I have tried to connect it with a patch of Lower Carboniferous conglomerate at Malignant Cove, but all connection appears to have been cut off by intrusive greenstone. Both are alike insulated by greenstone and separated from rocks of corresponding age. We have now reached the *ultima thule* of all geological investigation in this district prior to 1868. I now pass from the band of fossiliferous rocks which is so instructive and interesting to the Palæontological Geologist into another set of rocks, from which organic remains appear to be wholly obliterated. Before entering upon these, however, I would recapitulate to a small extent by describing the boundaries of the fossiliferous Silurian rocks of the district. On the north they are bounded by Northumberland Strait. Their eastern extremity is McNeil's Brook on the beach of the same Strait. On the west they are bounded by McAra's Brook, its Devonian slates and overlying sandstones, interstratified trap and limestones. The east branch of Doctor's Brook until it turns south, and its main branch until it turns to the same direction. Opposite Arisaig Pier are parts of its southern boundary. The remainder on the south side is obscure. Any continuation of these in a westerly direction lie under the carboniferous formation of Pictou County. As I have generally adopted the *ascending order* in my geological descriptions, I would now in this order record my investigation of the metamorphic band that lies to the south of the band already described. My starting point lies to the south of Doctor's Brook, about two miles from the coast on McDougall's mountain south of Bayfield's Beacon, 1000 feet above the sea level, according to Bayfield's measurement. I found the lowest rock here to be a *conglomerate,* very much hardened and shewing cleavage. When I first observed this rock, I imagined that I had found a lower carboniferous conglomerate in a very elevated and unusual position. I consider this as the equivalent of the Oneida Conglomerate. To the north of this and overlying it, are greenish quartzite strata, which on the surface is chalk white, and yields to the knife. Passing on the west, along the strike of the rocks, we come to McDonald's Hill, having an equal elevation of 1000 feet. In the rear of this is the same quartzite, south of the Frenchman's Barn. Still proceeding westward, we come to the main branch of Doctor's Brook—here the same quartzite is exposed rising from the Brook into lofty ridges. Farther west the mountain range continues south of Arisaig Pier, having the same quartzite with grit apparently corresponding with the conglomerate of McDougall's mountain. South of this, or under it, I found exposed in a field a considerable outcrop of syenite. I found all obscure in the rear or to the south of this. There is a table land with good farms, with the wilderness to the south. Passing westward in the rear of the mountains, I found this range apparently extending onward like a titanic rampart toward Merigomishe. I observed an outcrop of the same strata on a small bank south of McAdam's Brook referred to in describing the fossiliferous band of Arisaig. Observing a brook in the mountains N. W. of this, I attempted to find a path. I found a long, dreary and tortuous way in the shape of the bed of the main branch of Mill Brook. Where this Brook intersects the mountains, I found noble sections of the quartzite already pointed out, and other strata. I should have liked to have traversed the brook throughout, but I was diverted from my path by a bear which appeared to be disposed to dispute the right of way. As I did not feel disposed to dispute the matter, I betook myself to the steep side of the mountain, and at last regained the brook in safety, and emerged from it between lofty sides of the mountains with fine sections of argillites; passed through the north side of the mountain range with its outcropping argillites at the forks of the brook *i. e.* where the east branch unites with the main branch, near a lower carboniferous brine spring. Returning to the starting point at McDougall's mountain and proceeding eastward, we pass over the east branch of Doctor's Brook, and climb Mackintosh's mountain—we find diorite as the lowest rock with overlying argillites; these in the direction of their dip or northerly extend for some distance onward to the shore, forming mountains. To the S. E. of Mackintosh's and McDougall's rises McNeil's mountain, having according to Bayfield an elevation of 1010 feet above the sea level, being by ten feet the highest mountain of the range. This mountain consists of red syenite which rises abruptly on the south side, with a marsh and wilderness without any appearance of rock in the rear. The crown of the mountain is entirely syenite as well as its sides, in the cultivated land that rises up against it, and on the road leading to it we have as before, a succession of argillite extending northward to a certain point. We shall leave it there with the expectation of meeting it again.

I commence at the said point at McDougall's mountain again. I pass from the Oneida conglomerate in a northerly direction across the strata and towards the shore. I think I can separate the series into different members, but the operation is somewhat uncertain owing to the absence of fossils. My progress is arrested. The sides of the rock are precipitous, the ravine is of great depth; it extends east and west. From Doctor's Brook east to Doctor's Brook west it forms a valley for Arisaig Brook and east branch Mill Brook. It is filled with sapling bushes, marshes, &c. It is the highway for our old acquaintance bruin. The wool and bones of sheep show that he improves his opportunities.

On the south side of the ravine are lofty rocks—diorite—succeeded by a broad band of red slate, the exact counterpart of the supposed Devonian slate of Lochaber. This broad band extends to the insulated carboniferous patch already referred to at East Branch, Doctor's Brook, and its small tributary on the north which extends to the vicinity of the fossiliferous band; it extends westerly and terminates on the south side of the east branch of Mill Brook almost due south of the mouth of McAra's Brook. Here the lower carboniferous sandstones also rest on it unconformably as on the shore strata. It extends eastward under Doctor's Brook. It bifurcates and then trifurcates being divided by greenstones, its branches pass onward, eastward, the northern branch terminates in the *fort-like* rock at McNeil's Barn, near Malignant Cove. The middle branch passes on and is lost among brush, &c. The southern branch passes by not far from the *point* to which I brought the shale from McNeil's mountain, and proceeds onward and appears to terminate on the south side of Malignant Cove Sugar Loaf. Any continuation easterly must lie under the carboniferous areas which extend onward to St. George's Bay.

ART. II. REVIEW OF NOVA SCOTIAN DIURNAL LEPIDOPTERA. BY J. M. JONES, ESQ., F. L. S.

(*Read, Nov.* 14, 1870.)

NEARLY seven years ago, Mr. Thomas Belt read before this Institute a paper entitled "A list of Butterflies observed in the neighborhood of Halifax," in which he included no less than thirty species, the result of his observation and collection during the years 1862–3. Since that time I have been able to add a few new forms to the list, and also facts regarding the habits of the several species, and trust the same may be found of service in advancing our present knowledge of that interesting and beautiful class of insects.

SWALLOW-TAIL, (*Papilio turnus*, Lin.)

This butterfly which is far more common during some seasons than others, generally makes its appearance about the first week in June. Mr. Belt says the 1st of June, but I have failed to note its presence before the 7th of the month. A pleasant sight it is to the eye of the entomologist to observe about the middle of that genial month a lilac (*Syringa vulgaris*,) covered with its purple masses of luxuriant bloom, on which may be seen many of these pretty insects revelling in their honied sweets. Flitting alternately from flower to flower, their delicate wings of lemon striped with black, contrasting with the more sober colour of the flower, presents a scene of natural beauty, sufficient to attract the attention of the most heedless. That these insects have very acute olfactory organs, I have had frequent opportunities of observing, and I can safely say that they can scent the odour of lilac flowers when a moderate breeze is blowing, for I have stood and watched them, at a distance of 150 yards to leeward. Canadian entomologists state that there are two broods during the summer in that part of the Dominion, but in Nova Scotia, I think there is only one of this species. A perfect community of these gaudy butterflies may be seen occasionally hovering over and lighting upon wet spots on roadways during the month of June, and I have observed that they are by no means particular as to the nature of such moisture, for I have several times seen them congregate in manure where horses have lately staled. Gosse in his very interesting work "*The Canadian Naturalist*," remarks their fondness for wet spots, and says that he has counted as many as fifty-two in one such situation, but no author that I am aware of has ever noted the circumstance of their fondness for urine.

This species is found, more or less abundantly over the N. A. continent as far south as Mexico, and as far north as Fort Simpson on the Mackenzie River—according to Gosse it is also found in Newfoundland.

Pontia oleracea, (Har.)

According to Mr. Belt we have two kinds of this common butterfly; the first at the end of May, and the other in July. In August abundant over potatoe patches.

This is one of the pests of the horticulturist, for it lays its eggs and the caterpillars are hatched, upon the cabbage cauliflower, and other oleraceous plants. In Nova Scotia we have however, but little reason to complain of its ravages, for it is not what naturalists would term abundant. It would have been a fortunate circumstance had we only this one species of cabbage butterfly to damage our crops, but as I shall show presently, we now possess a perfect demon in this respect, which far outvies our native insect in destructiveness.

It is distributed over the northern portion of the United States, and the British Provinces.

Pontia rapæ, (Steph.)

Although an Englishman and justly proud of the productions of my native land, yet I must confess that in introducing to the notice of the farmers and gardeners of Nova Scotia, this the well known small cabbage butterfly of England, I am for once ashamed of my fellow-countrymen, for of all the persistent destroyers of cabbage, or cauliflower, perhaps this is the worst. All kinds of remedies may be applied but still their green caterpillar does its work, and whole beds of choice cauliflowers will become so leaf-eaten that they will barely show a head larger than a dahlia. In my own garden last summer I had a plot of some seventy or eighty cauliflowers entirely ruined by this insect, and I heard repeatedly from the country people in the market that they had suffered in a similar way. It has only been known in the North American continent within the last few years, having been introduced from Europe. It was observed in Canada Proper some years ago, and has been making its way eastward rapidly, until about three years ago it first became known about Halifax. That it will increase and finally overrun the Province, is very certain, and farmers and gardeners will now have to lament the destruction of their cabbage and cauliflower crops just as they do the red currants; and when they consider that in this country we do not possess the sparrow and tomtit, those inveterate enemies of insect life in all its forms, it is really a matter for the serious attention of agricultural and horticultural societies, whether it would not be advisable to introduce these birds in order to counteract such injurious effects. The citizens of New York, and I believe some of the Canadian towns, have already introduced the common house sparrow of England, and apart from its cheerful appearance and recall of home remembrances, the good it does in clearing away myriads of injurious insects might be a sufficient inducement to recommend it to our local authorities.

Colias philodice, (Godt.) "Clouded Sulphur."

This may be considered our commonest butterfly; at least in the neighbourhood of the Atlantic coast. They do not appear abundantly in wet seasons.

First appearance, June 4th, 1866.
Latest, " 1st week in November.

frequenting the flowers of the fall dandelion, (Leontodon autumnale) the only field plant left in bloom.

Although a field may appear covered with them, yet if a cloud overshadows the same for even a few minutes, not a *Colias* is to be seen. It is a happy circmstance that this species is not destructive to our garden crops, merely resorting to the plants of the field for nourishment in the caterpillar and *imago* states. It resembles greatly the clouded yellow (*Colias edusa,*) of England. There are two broods of this species, the first in May and the last in July or August. Mr. Belt says that there are probably three broods, but as in the case of some birds which breed earlier or later according to circumstances, I fancy the newly born specimens of this butterfly which we see in September, are late cases of a second brood.

Danais archippus, (Fabr.)

This may be considered a very rare species in Nova Scotia, only a few specimens being observed each summer. In the autumn of 1863, Mr. Belt took a few specimens on the Citadel hill, and about that time I saw a specimen in the hands of a child in the Dutch Village. Mr. Downs, however, informs me on the authority of Mr. John Winton, that it is not so rare in the valley of the Shubenacadie. This large and handsome butterfly is very common in the Bermudas, where I have taken several specimens as well as the caterpillar which feeds upon the ipecachuan plant (*Asclepias curassavica*). It is also common in Lower Canada, United States, and I believe also the northern parts of South America, for I have specimens which were blown on board a vessel when off Cape St. Roque in Brazil, at which time perfect clouds composed of this and three or four other species of butterflies literally darkened the sky. These enormous gatherings of butterflies blown off the coasts of different countries, are alluded to by Darwin and the naturalists who have personally witnessed them. They are supposed to be migrating.

Argynnis aphrodite, Fab.
A. cybele, (Godt.)

This may rank second as a common species in our Province, being very abundant during the latter part of our short summer. It is in the month of August that the collector will find the most perfect specimens, as later on in the early part of September they are generally observed with damaged wings. They appear to be partial to the flowers of the blue michaelmas daisy, and occur more frequently in the depths of the forest far away from cultivation than any other species. It appears to be common in Canada, and the northern part of the United States.

Argynnis myrina, (Cramer) "*Myrina Butterfly*" "*American Pearl bordered Fritilla.*"

This is one of our commonest species, generally appearing in the neighbourhood of Halifax about the beginning of the second week in July. At the close of that month they are perhaps most numerous, frequenting the warmer and healthier spots, where on the blossoms of the white-weed (*Lucanthemum vulgare*,) they appear perfectly "at home." Another favorite locality is a log road in the forest not far from the settlements, where the sun pours down its hottest rays. Here in company with sundry "skippers" the pretty little Myrina flits from spot to spot, opening and closing its chequered wings unmolested save when a stray entomologist passes by. Mr. Belt reports two broods during the summer.

Melitœa ismeria (Boisd.)

Mr. Belt records the capture of this species at Lake Loon and Lake Thomas, Halifax county, in July, but puts it down as "scarce." Harris in his "Haunts of Man," states that he had only seen one specimen. It is not a northern species, but is chiefly confined to the southern United States.

Melitœa Tharos, (Cramer.)
M. tharossa, (Godt.)
M. Pharos, (Drury.)

Very common, generally observed in company with the former species and the skippers.

Grapta interrogationis, (Godt.)
G. aureum (Cramer.)
G. calereum, (Gom.)

Mr. Belt caught one of this species in the Horticultural Gardens in Aug. 1863. I have not heard of any other instance of its capture in the neighborhood of Halifax. It is common in the northern United States and Upper Canada.

Grapta progne, (Cramer.)
Vanessa progne, (Godt.)
V. c argenteum, (Kirby.)

It appears to be widely distributed over the northern parts of America, being found within the arctic circle and as far west as Fort Simpson on the Mackenzie.

This is a somewhat common species about Halifax, appearing in a damaged state early in the summer. These early broken winged specimens are those that have secreted themselves in some sheltered situation during the past winter, and perfect examples of the year's brood are not seen before the beginning of July.

Grapta Comma, (Harris.)

This species appears to be so variable in its markings that entomological authors are much divided in opinion as to whether there is more than one species. Mr. Belt showed me two well defined varieties, which he declared were persistent, as he had examined numbers of each, and the markings always exhibited the same difference. The commonest of England (*Grapta C. album*) which is very similar if not identical with our species, is also liable to variation of marking, so probably it is one of those forms several of which are known to zoologists, liable to variation according to external circumstances.

Two varieties are found near Halifax, yet they are very locally distributed.

Grapta argenteum, (Kirby.)

Under this name a species is included in the *Fauna Boreali-Americana*, and Mr. Belt places it in his list as one of our Nova Scotia forms. Harris considers it as a variety of *G. comma*. The shores of the Dartmouth Lakes and shore of Lake Loon are given on Mr. Belt's authority as its habitats. Mr. Belt observed it as numerous in spring and autumn near the Dartmouth Lakes and Lake Loon.

Vanessa J. album, (Boisd.)

This butterfly may be considered rare in the neighbourhood of Halifax, and as far as I have been able to ascertain, equally so throughout the Province. Two or three specimens are the most I have seen during a season. It sppears to be equally scarce in the northern United States and Canada.

Vanessa milberti, (Godt.)
V. furcillata, (Say.)

This species has not been observed in the neighborhood of Halifax, but has been taken in Truro and Windsor, or farther to the north. This small and prettily marked species is a true boreal form, being found as far north as lat. 63° in the Hudson's Bay Territory. In Newfoundland according to Gom it is the most abundant of all the species found there. It is also common in Canada but rare in the United States.

Vanessa antiopa, (Linn.)
Papilio antiopa, (How.)
Engonia antiopa, (Hubn.)

This species which is extremely rare in England is the very reverse with us, being found everywhere in abundance. (It is also found in Prince Edward Island, whence I have received a specimen captured at Charlottetown, and kindly forwarded by J. S. Carvell, Esq.) So early as the first week in April if the sun comes out bright and warm, isolated specimens, hibernated through the last winter, shew themselves in our gardens and flit through the streets, delighting the children with their presence, a pleasant sign of the coming summer.

Pyrameis atalanta, (Donb.)
Vanessa atalanta, (Fabr.)
Papilio atalanta, Linn.)
Ammiralis atalanta, (Renn.)

This is a rare butterfly in the neighborhood of our Atlantic coast. Harris thinks that this species which is common in Europe, was introduced into America with the common nettle. It is especially abundant in some parts of England and Wales, particularly the west of Shropshire and eastern part of Montgomeryshire, where I have seen numbers together on the purple flowers of the common scabious in the month of August. It is found very far north on the American continent, and as far south as Mexico, including some of the W. I. Islands. It occurs but rarely in the Bermudas.

Pyrameis cardui, (Donb.)
Papilio cardui, (Linn.)
Cynthia cardui, (Kirby.)
Vanessa cardui, (Godt.)
Libythea cardui, (Lam.)

This species which may be considered one of the most errant forms on the globe, being found in every part of Europe, Asia, Africa and America, Australia, Pacific Islands, is also common with us. It appears to be equally at home on the icy slopes of Hudson's Bay or the heated plains of Africa—in the centre of the European continent or on the small rocky islets of Bermuda. The only difference I have observed in the several insects from such localities in the British Museum collection, is in the depth of colour of the wings—those from northern climes being of a brighter and fresher colour than those of the tropics. Probably the heated rays of the equatorial sun tend to fade them.

Pyrameis Huntera, (Donb.)
Papilio Huntera, (Abb. et Smith.)
P. Lole, (Cram.)
P. cardui Virginiensis, (Drury.)
Cynthia Huntera, (Kirby.)
Vanessa Huntera, (Steph.)

This species is quite abundant some seasons, but equally scarce in others. It appears very late about the end of September, and may be seen on the blossoms of the Fall dandelion (*Leontodon autumnale*) as late as the third week in October. It is some years quite as common as the Painted Lady B. According to the synopsis of N. Am. Diurnal Lepidoptera, published by the Smithsonian Institution, the United States specimens are as large as P. cardui—with us they are perceptibly smaller. The Citadel Hill was a favorite resort of this as well as other desirable species, but unfortunately that excellent preserve during the last few years has been closed to this entomologist.

Nymphalis arthemis, (Drury.)
Nymphalis artemis, (White.)
N. lamma, (Fabr.)

This fine strong-winged butterfly is by no means common in the neighborhood of the Atlantic coast, nor do I think it is more abundant in the interior. It is difficult to capture from its rapid flight and habit of flying high, and it seems to be partial to the forest, where it loves to bask on some hardwood leaf, opening and shutting its wings to the sun. I have observed it has a habit of returning to the very same leaf it rested on when first surprised, and if the collector remains perfectly still he will generally in a few minutes time have another chance of netting the specimen. They appear also to be partial to old roadways on the borders of the forest. It appears about the first or second week in July, and I have seen it still about on the 11th of August. It is a boreal form, being found on the American continent as far north as lat. 63° but seldom farther south than 43°.

Nymphalis disippus, (Gordy.)
N. misippus, (Fabr.)
N. archippus, (Cramer.)
Limenitis ursula.

Several species as a rule may be considered local in their distribution, being much influenced by the geological or botanical features of the country; several species found on our barren

Atlantic coast being unknown in the interior or on the Bay of Fundy shores, where the rich alluvial soil gives nourishment to a more luxuriant vegetation. In the valley of Annapolis, during the past summer, I had an opportunity of observing during a stay of only two days the very great dissimilarity of its insect fauna compared with that of the neighbourhood of Halifax. With the exception of *Lycæna Americana*, and one or two *Hesperians*, I did not observe about Annapolis itself, any of our more common species, where *Satyrus alope and Erebiar nephile*, species never seen with us were extremely abundant. I feel certain that it only requires more thorough investigation to render this distinctive character more apparent. The North Mountain if traversed from Digby Neck to Blomidon, would probably afford many rare if not new species.

Art. III. On the Copper and Nickel Mines at Tilt Cove, Newfoundland. By Elias Marett, Esq., St. John's, Newfoundland.

(Read December 12, 1870.)

Tilt Cove, situated on the north side of Notre Dame Bay, and about ten miles south of Cape John, a mere notch in the sea wall, has nothing particular to distinguish it from any other similar indentation on the same coast line of rugged lofty cliffs capped with a growth of stunted spruce and fir trees. A wharf and a few fishermen's huts are alone visible on first approaching the landing place. A few paces, however, across a narrow neck of land, suddenly conduct the visitor into the midst of a busy thriving town, which until lately, was part of the unreclaimed wilderness. This is the now notable mining centre of the "Union Mining Company."

The almost sudden transition, from a wild rock-bound coast, to a neat, clean, and orderly town, is as pleasing as it is unexpected. The town is built on the sides of a bowl-shaped hollow, the centre of which is occupied by a lake, at the foot of lofty precipitous hills, which completely encircle the place and shut out all view of the sea or surrounding country. The Mine has been opened within the last five or six years, and operations pushed forward with a vigour and energy almost incredible. Before the opening of this mine, "Tilt Cove" was inhabited by only a few fishermen and their families; now, it contains a population of some twelve hundred people, all connected with, or dependent on the works. Roads had to be made in all directions, tramways laid down, wharves and bridges built, dwellings, stores and workshops erected—everything, in fact, had to be done to redeem from the wilderness a place suitable for habitation and adapted to the exigencies of trade and commerce. The settlement is now one of the most, if not the most thriving of any in the colony. There is a resident doctor, a clergyman (the Rev. J. Lockward) and a school master; a new church—one of the handsomest and most substantial wooden buildings I have ever seen in the colonies, has been erected for the benefit of the inhabitants, by the liberality of the proprietors. The police is admirable and order and quiet reign throughout.

The mine was opened in 1864, and the progress has been so rapid, that, in 1868 not less than eight thousand tons of copper ore were shipped to the mother country; last year (1869) about six thousand tons were despatched; the decrease in the quantity exported does not imply any diminution in the amount of mineral brought to the surface, but rather was occasioned by the state of the home markets. At all events, the deficiency was amply made up by the discovery of a rich vein of Nickel, greatly exceeding the value of the copper, and of which thirty-three (33) tons were shipped last year. In the present year, eighty (80) tons of Nickel have been exported, and during my visit, from seven to eight hundred tons of copper ore were despatched to England; while at the time of my departure, one vessel was loading at the wharf and two others were awaiting their turn. In order to avoid error, I ought, perhaps, to mention that the "copper" does not exist in veins but in deposits, technically called by the Cornish miners "pockets" or "bunches." The copper is shipped either crushed, washed and culled, or only broken and culled, then transported to the ship's side in waggons containing nearly two tons each, by means of a tramway on a slight incline, in a rapid and expeditious manner. The crushing is performed by means of a powerful steam engine. A difference is observed in the washing of the copper and of the nickel ores. The former are cleaned and culled by the process of jigging, but the finely crushed Nickel is washed and picked out by means of a graduated sluice, very much in the same manner as the gold washings; when dry, it is then barrelled up ready for exportation. I was told that thirty tons of this valuable mineral were then ready for shipment. The proprietors, Messrs. Bennett & McKay, are said to have shared, after deducting all expenses, £32,000 of profits between them, for the year 1868. Now that they have all the plant, and with the Nickel vein in full operation, it would be difficult to say how much more important the future results may become. It is said that an offer of £200,000 was made for the Mine by a London Company, which was declined.

The Geological Surveyor, Mr. Murray, says in one of his reports: "It would be difficult to imagine a place more conveniently situated for the commencement of mining operations than this at Tilt Cove. The lofty vertical cliffs which rise on every side give unmistakable evidence of the presence of mineral wherever it exists; which, were the ground of a more rounded or gentle character, would necessarily be more or less concealed. All the work hitherto done has been carried on in drifts at a higher level than Windsor lake, thereby avoiding all necessity for pumping-engines, or danger from inundations; while the position of the place, by its proximity to the sea, for embarking ore, is in the highest degree advantageous. The rock with which the ore is immediately associated appears to be a chlorite slate, very ferruginous, with seams of serpentine, and having huge intercalated masses of a hard, compact, greenish-grey crystaline rock."

Perhaps the most remarkable feature of Tilt Cove is the Nickel vein. This is situated in the midst of a ferruginous hill, directly facing the settlement, and which might, without stretch of imagination, be taken for an enormous mass of rusty iron, the refuse of cyclopean furnaces.

The whole of the peninsula of "Notre Dame" is highly metalliferous, and is almost entirely taken up by adventurers holding mining licences, or rather licences to search for minerals within certain prescribed limits. Everywhere along the sea cliffs indications of copper and iron are plainly visible, cropping out among the serpentines, which are exceedingly beautiful and varied.

If a line were drawn across the Island from Notre Dame Bay to Cape Ray, the territory lying to the north and West of that line would represent the metalliferous region of Newfoundland, at least, so far as is yet known. The government survey is now in full operation, and the surveyors are this year working their way across the Island from Bay of Despair to Notre Dame Bay.

A few miles from "Tilt Cove," a second Mining Company—that of "Notre Dame," has commenced operations, but as the mine has been opened only within the last twelve months, the works are much less extensive; though the prospects seem not inferior to those of the Union Mine. There are several other places where workings have been commenced on a small scale, but either from lack of enterprise or of capital, the results have not been fortunate and the works languish.

There can be no doubt that the results of the geological survey will reveal much that is both valuable and interesting, and hitherto unsuspected, and will attract to the colony that which it stands so greatly in need of—enterprise, capital, and population. With failing, or, at the best, uncertain fisheries; there is great need of new industries. The self-interest of a few individuals, acting upon the ignorance of the mass of our people, has hitherto been the means of keeping out capitalists and checking immigration. It can scarcely be possible, however, that this state of things should be of long continuance. And Newfoundland once thrown open will then take her place and be welcomed as an equal in the confederacy of the British Provinces, instead of being regarded, as she now is, as only a "few barren rocks where the fisherman may dry his nets."—*July*, 1870.

October 25*th*, 1870.—Since the above was written the Rev. Jno. Lockward has been in town, and told me that on account of the failure in the demand for copper and nickel, owing to the present war and other causes, the works at Tilt Cove are in a great measure suspended, and a large number of the operatives dismissed. It appears that the proprietors have not effected any sales this year and consequently have large quantities of ores lying in their stores in England. This check cannot be considered otherwise than as a partial hindrance, which it is to be hoped will soon be removed. The surveyors also have returned without accomplishing their intended route, owing to the want of water and failure of stores. I believe they returned upon their route when half way across. It is true that we have had an exceedingly dry summer.

ART. IV.—RECORD OF OBSERVATIONS ON THE GEOLOGY OF NOVA SCOTIA, SINCE 1855. BY REV. D. HONEYMAN, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

(Read December 12, 1870.*)*

I PROCEEDED from Arisaig to examine the district about Antigonish, I took the road that passes along Arisaig Brook and Doctor's Brook, through the mountains. South of these mountains before descending into the lower ground I found a considerable outcrop of Lower Carboniferous Limestone, shewing the existence of the Carboniferous formation in this direction. Having reached Antigonish, I commenced the examination of the subtriangular area of rocks, of which the Sugar Loaf forms a part.

In this band there are two anticlinals and an intermediate synclinal. The south side of the one anticlinal is overlaid unconformably by carboniferous strata, and so is the north side of the other. The axis of the southern anticlinal is in the line of the summit rock of the Antigonish Sugar Loaf. This rock is greenstone. The line of the northern anticlinal is about two miles north of the Sugar Loaf. The greenstone of this axis is exposed in an outcrop on McDonald's farm near the Gulf Road, and also in McDonald's Brook to the east. This axis extends eastward and outcrops on the side of St. George's Bay. It also extends westward and outcrops in a bluff east of Saml. Cameron's. This area of metamorphic Arisaig strata is bounded S. W. and N. by carboniferous strata. In a small brook at the side of the Gulf

Road the limestone of the Doctor's quarry and their underlying conglomerates, are seen to lie unconformably on slates having their cleavage joints glistening with scales of micaceous peroxide of iron. The slates are the extreme outcrop of the south side of the southern anticlinal; they dip at an angle of 55°, while the unconformable conglomerates and limestones dip at an angle of 30°.

These facts are obvious, and the conclusion simple and prosaic; somewhat different it will be deemed from the poetic and lofty imaginings of some theorists, who, without observing facts, have seen the Sugar Loaf with its elevation of 710 feet (Bayfield) and its congeners with a glorious saddle of thousands of feet of carboniferous strata which have disappeared as if by magic, by the glorious agents of denudation. These have succeeded wondrously in establishing a connection between the various carboniferous areas of Nova Scotia and Cape Breton, and of these conjointly with other carboniferous areas of the American Continent in defiance of all interposed obstructions and the sterling principles of Inductive Philosophy.

The summit of the Sugar Loaf is about 1½ miles from Antigonish—the second axis at McDonald's Brook is four miles from the same town and the mountains at Walsh's, the northern exposure of the Silurian area. This appears to have been a small subtriangular island in the sea of the lower carboniferous period. There is a great band of conglomerates and grits with limestone and gypsum on its southern side, which separates the Sugar Loaf Silurian area from the great area of which the mountains of Arisaig form a part. This lower carboniferous band connects the carboniferous area which lies to the north of the Sugar Loaf area and stretches to St. George's Bay with the great carboniferous area which lies to the south of the same area, and stretches to the Strait of Canso. This band of conglomerates is an anticlinal—the axis of this is concealed. It seems to be a continuation of the northern axis of the Sugar Loaf area—the same axis seeming to pass into the other Silurian area. Whether this is the fact or not, remains to be proved by future investigation.

The gypsum deposits which lie to the south of the Sugar Loaf area, and skirts it throughout its length extending along the carboniferous conglomerate to the west, and skirting the other Silurian area on the south, onward to James's River, the longitudinal extent being about fifteen miles, and extends to the settlement of lower South River, breadthwise across the harbor. These have manifested the existence of reservoirs of brine and saliferous clays, having a thickness of at least six hundred and ten feet. This accounts for the existence of the salt pond to which I referred, and on the origin of which I speculated in my paper on the Geology of Antigonish County, *vide* Transactions of the Institute, Vol. 2, Part 4.

In this area, situate on the south side of Antigonishe Harbour, there is a very interesting exposure of syenites and overlying limestones, which want more than a passing notice. A plan of these, which I made for the Geological Survey, coloured, presented a very curious appearance. The two rocks conjointly form a noticeable hill of the elevation of three hundred feet above the sea level, according to Bayfield. On the summit the limestone is parted by the syenite: the one and the other contending for the supremacy. The limestone forms the summit rock; the limestone is highly fossiliferous throughout—the prevailing fossils are *cyrtoceras*, *connularia*, *dentatium*, and *leperditia*. *Leperditia Okeni* is very abundant. The limestone here has this fossil in common with the Windsor limestones. I believe I found this organism in the Windsor limestones prior to its discovery by Mr. Hart, and I identified it as the Leperditia Okeni in the Hunterian Museum of the University of Glasgow in 1865. When I was Commissioner at the Dublin Exhibition, I found its representative in the fine collection of Leperditia and other entomostraca belonging to Dr. Hunter, Curator of the Museum. Another fact connected with the limestone in question is, that it does not appear to be affected by contact with the syenite, in the way that the Oneida conglomerate of Arisaig has been affected by contact with the greenstone. In contact with the syenite, I found the limestone and its fossils without the slightest appearance of alteration. I collected specimens of connularia from the summit limestone in as good condition as any connularia that I had met with. This shews unquestionably that the syenite is different in its origin from greenstone, and also that the process of metamorphism, by which it acquired its present constitution, was complete before it attained its present position; and that the limestones were formed directly upon the syenite in the bottom of the sea of the carboniferous era. The conglomerates around Antigonishe and Cape St. George have had a good deal of attention given to them. I was long puzzled to know whence they derived the most of their pebbles. One large mass on the shore of St. George's Bay, north of Ogden's, contained a boulder of coarse red granite, such as is to be met with at Sherbrooke and Country Harbour, but not nearer, as far as was known or suspected. The grits of Yankee Grant which are used in the construction of the Antigonishe cathedral, are micaceous in a wonderful degree. The question arose whence came the mica? The grit in Malignant Brook, to the North of St. Mary's chapel, are equally micaceous, whence comes the mica? The sandstones with carboniferous flora at Graham's Brook, near Cape George, were also very micaceous. In short, the farther the lower carboniferous strata became removed from known granitic rocks, the mica appeared to increase in proportion. All was made clear, or nearly so, by the discovery of an interesting series of rocks on the shore of Northumberland Strait, where I had long assumed the existence of a continuation and connection of the conglomerates of Malignant Cove and Cape St. George. This band, which is of considerable breadth, consists of diorites, hornblende rock, ophite, ophiocalcite, black quartzite, with quartz veins, having abundance of crystals of silvery mica. Succeeding these are bands of white and red syenite, having veins of green felspar. These syenites are sparingly hornblendic. Without much hesitation I concluded that I had discovered a band of Laurentian rocks, the ophiocalcites particularly leading me to this conclusion. I had never seen the Laurentian rocks of Canada, but I had seen and studied the fine collection of specimens of Laurentian rocks in the Canadian and Newfoundland departments, in the Paris Exhibition of 1867. This collection was exhibited by the Geological Commission of Canada. The part of the collection in the Canadian department was distant from the front of our court only the breadth of the passage, and the Newfoundland part not six feet from the door of my office; so that the collection and I became somewhat familiar in the course of six months. I thought I had met my Canadian acquaintance at Arisaig. The discovery of Eozoon, by Drs. Dawson and Hunt, in specimens of the Arisaig ophiocalcite has confirmed this opinion. In all probability this band of metamorphic rocks is overlaid unconformably by lower carboniferous strata. Passing from Malignant Cove along the road to Antigonishe we meet with a good outcrop of sandstones These lie to the east of the terminal range of the Arisaig mountains, *e.g.* Sugar Loaf and McNeil's mountains already referred to. A continuation of these sandstones eastward will pass south of the Laurentian rocks, without giving much room for intervening rocks. This region is forest. In this Laurentian series, it will be observed, there exists mica sufficient to account for the micaceous character of the grits and sandstones already referred to. Many of the pebbles of the conglomerates also noticed may have come from this quarter. The only desideratum is a rock which could furnish the red granite boulder of the mass of conglomerate found on the shore of St. George's Bay. Although the rock has not been found, there is every probability that it may be found there. Of this we are certain at least, that all the constituent minerals are there, although I have not found them united in the same rock, so as to form the rock required. I go a step farther, and regard the syenite of McNeil's mountain with the middle and upper silurian metamorphic overlying it, and also the syenite with the overlying Leperditia limestone as outcrops of the Laurentian series; and then I would adopt Professor Hind's view of the character and age of the granite, and regard the Sherbrook and Country Harbour rocks as outcrops of the same series, and consider that one process of metamorphism affected the whole of this class of rocks in Nova Scotia.

I find the following observation in Acadian Geology, Ed. 1855, chap. 14, Devonian and Upper Silurian Systems, page 311, "Granite composed of distinct crystals of quartz, felspar and mica. Granite is a rare rock in this district, though found in great masses in the other metamorphoric districts.

In my paper on the Geology of Londonderry Iron Mines, read before this Institute in winter 1866–7, I noticed the existence of granite among the rocks underlying the slates containing the iron ores. These observations converge to the same point.

I have already observed that I found granite in a mountain at Big Baddeck, and was thereby led to infer and maintain that the auriferous slates of Wagamatcook, or Middle River Cape Breton, lying at no great distance from the mountain, were Lower Silurian metamorphic, like the slates of Nova Scotia Gold Fields. I would now observe, that among the specimens of polished marble sent to the Paris Exhibition from Nova Scotia there was a specimen of green marble (serpentine) exhibited by W. A. Hendry, Esq., Deputy Commissioner of Crown Lands. This specimen attracted some attention. It was particularly noticed by Dr. Sterry Hunt, of the Canadian Geological Commission, and Professor Lesley. Professor Wyville Thomson, of Belfast, also noticed it, and detected in it what he called Eozoonal structure. He asked me where it came from, and from what geological formation. I replied, from Cape Breton; that I had not examined the locality; that Dr. Dawson in his Acadian Geology had supposed that Devonian rocks prevailed in the region. Considering that the specimen would be of service in proving that the Eozoon Canadense was not organic, he asked for the specimen and received it. The specimen excited some commotion in London, among the Eozoonal controversialists. Dr. Hunt cognizant of all this, ventured to make the following forecast. "A line drawn from Malignant Cove (Arisaig) Laurentian to Newfoundland, will pass through Cape Breton, we may now expect to find limestones with Eozoon there." (Professor Hind's letter, addressed to Hon. R. Robertson, Chief Commissioner of Mines, Nova Scotia—*Chronicle Newspaper*.) Whether this specimen has Eozoon structure or not, there is one thing certain, that the specimen resembled the Laurentian of Arisaig, and there is every probability that the Cape Breton ~~Laurentian~~ Serpentine and the Arisaig are of the same geological age—Laurentian. With a view to a farther elucidation of the subject, I requested Mr. Murray, student of the Presbyterian Theological Hall, when going to Cape North, C. B., last spring, to bring for the Museum specimens of the prominent rocks. Among the specimens which he brought there are very coarse granites;—two from Whitehead, Aspy Bay, one from a granite rock situate about fifteen miles from Cape Ray, or seventeen and a half miles S. S. W. from Whitehead. The felspar of the specimens is flesh coloured; the quartz glassy white and red; the mica black and white. Some of the plates of black mica are 1 x ¼ inch; others 1¼ x 1 inch. The inland specimen of granite is the exact counterpart of the specimen from the mass of conglomerate in St. George's Bay: this is a coincidence. Comparing a specimen of the red syenite of the Laurentian at Arisaig, with a specimen of the red syenite of the syenite and limestone mountain S. of Antigonishe harbour, I find that the latter is much more hornblendic than the former. I find in the specimen of the Antigonishe harbour syenite a plate of green mica, the same as the mica of the specimen of granite from the Big Baddeck mountain. Mr. Hendry has kindly located Wagamatcook Gold Field and the St Ann's serpentine on a map of Cape Breton, belonging to the Crown Land office. This map is on a scale of 2½ miles to the inch. Upon the same map, Mr. Murray and Mr. Austen, of the Crown Land department, have located for me the rocks in the district of Aspy Bay, which produced the specimen of granite. On drawing a straight line on this map from Baddeck mountain so as to bisect the line connecting Whitehead with the locality having the granite, seventeen and a half miles S. of W. from it—of course this is only to be considered an arbitrary line—I find that Wagamatcook auriferous slates is five miles from the line on the one side, and St. Ann Laurentian three miles from the same line on the other side. These facts are somewhat striking, and may indicate Cape Breton as the meeting place of undoubted Laurentian and auriferous silurian, and as connecting Arisaig Laurentian with the granites of the Nova Scotian Gold Field.

In this way we come to the conclusion at which Professor Hind had arrived, by a shorter process, in reference to the Geological age of the gneissoid rocks of Nova Scotia and Cape Breton.

It will be observed that there are certain great geological formations that lie between the Laurentian and Middle Silurian which have no representative at Arisaig or the other localities which it represents, viz., the Huronian or Cambrian, and the Lower Silurian. Dr. Dawson in his Acadian Geology, 1st Ed. pointed out the band of rocks on the Atlantic coast which are the gold bearing rocks as Lower Silurian. I imitated his example in maintaining this view in the Geological Society in 1862. Dr. Dawson still maintains his position in his Ed. of 1867. Prof. Hind has lately advanced a step farther, and shews the granite to be gneissoid and Laurentian, and the overlying formations which constitute the band in question to be Cambrian, Huronian and Lower Silurian.

I have heretofore chiefly appealed to the evidence of fossils, directly or indirectly, in proving geological age or succession.

In investigating the Nova Scotian auriferous band of rocks, this kind of evidence appears to fail us. I have searched long and diligently among the grits and slates of this series of rocks, for fossils, but hitherto without success. I have found from time to time, above the rocks, or in them, what I considered to be fossils, or possibly fossils, the former turned out to be of carboniferous age, the latter, mineral structure. I am afraid that the experience of other observers has been somewhat like my own. It is then, as heretofore, on other grounds that I regard the rocks in question, as differing from the non-crystalline rocks of Arisaig, and as at least contributing to fill up the gap mentioned. During my term of service in the Geological Survey of Canada, I made what I believe to be a complete collection of the Middle and Upper Silurian rocks of the counties of Antigonishe and Pictou, These are to be found in the Provincial Museum, along with representative specimens of the rocks of the auriferous band collected at Waverly, Wine Harbor, Halifax and Dartmouth, &c. There is no possibility of confounding the two sets of rocks.

There is no rock in Antigonishe or Pictou that can be mistaken for the pyritiferous and andalusite slates of the N. W. Arm and Point Pleasant—the same may be said of the pyritiferous grit called *whin*. The argillites have altogether a different aspect from any of the argillites of Antigonishe or Pictou. The Oneida conglomerate and the Medina sandstone, unaltered or altered, have no resemblance whatever to the grit or *whin*. The Clinton altered slates with their iron deposits, and abundance of quartz veins, occasionally slightly resemble some of the auriferous argillites, and have thereby attracted the attention of gold seekers, and given occasion for newspaper announcements of gold discoveries. But the slates cannot for a moment be mistaken for those of the Gold

Fields, by the practised eye, and the search for gold in these veins of quartz has been a vain one, and the reported discoveries have no foundation in fact. Arisaig, East River, Irish Mountain, Sutherland's River, and Antigonishe, have all had a short-lived reputation of this kind. Cape Porcupine belongs to the same category except that its reputation has assumed a permanent form, having been perpetuated in the pages of the progress volume of the Geological Survey of Canada, 1869. We read thus, page 745, "In Nova Scotia although the gold occurs throughout the coast series, it is also said to be found at Cape Porcupine in rocks of the same age as these upper slates (Silurian or Devonian.) This probable identification of a part of the gold formation of Nova Scotia, with the altered Upper Silurian and Devonian strata of Eastern Canada, gives an additional economic interest to these rocks whose metalliferous character has already been commented upon on pages 711 and 734."

One of the best sections of the Clinton argillites of the regions referred to, is on the line of railway from Pictou to Truro, commencing near the Gairloch station and proceeding onward towards Truro. A passing observer can easily distinguish the difference between the argillites there exposed and the argillites of the Gold Fields seen in sections on the Railway from the Grand Lake toward the Junction and Still-water between Mount Uniacke and Windsor. I would yet advance another reason, which I regard as shewing the priority in time of the rocks of the Gold Fields. These rocks *e. g.*, between Freshwater and Point Pleasant, exhibit a higher degree of metamorphism than those of the Arisaig Middle and Upper Silurian series, (metamorphic,) with flexures and contortions which the others do not exhibit, such as are to be seen in the Lower Silurian of the Highlands of Scotland and in Wales.

This appears to me to be at least presumptive evidence of unconformability existing between the Arisaig series and the Gold Fields. It would have been more satisfactory if we had had the one set of rocks directly superimposed on the other. This, I have been altogether unable to find. It may be considered that I have been here labouring to prove what is universally taken for granted. I have already stated that the opinion has been maintained by eminent authority, and that the priority of the auriferous formation to the Middle and Upper Silurian has not been universally conceded, or is altogether so evident as most people appear to imagine. There appears to be some reason for supposing that the rocks in question may be Devonian, as the only rocks found directly superimposed upon these are the unquestionable lower carboniferous. If this were taken as indubitable or even presumptive evidence of the position, it would carry too far and lead to the conclusion that every argillite immediately overlaid by lower carboniferous was Devonian, and we would thus be carried back to a very remote period in the History of Nova Scotian Geology, if any such period ever existed. It will be observed that all that I attempt to prove is that the auriferous slates and grits of Nova Scotia are older than the Middle and Upper Silurian, and newer than the Laurentian, and may be Cambrian or Huronian, or Lower Silurian or both. If they are Huronian and Lower Silurian, as Prof. Hind seems to have established, then Nova Scotia has a complete series of formations from the Azoic or Eozooic to the last of the Paleozoic series, viz: Laurentian, Huronian, Lower Silurian, Middle Silurian, Upper Silurian, Devonian, Carboniferous, New Red Sandstone.

Art. V. Remarks on the Geology and Physical Geography of the North-east Coast of Kent (England.) August, 1870. By Alfred S. Foord, Esq., London.

(*Read January* 9, 1871.)

My attention was first directed to that part of the coast of Kent between Ramsgate and *Broadstairs, covering a distance of about five miles, and consisting of the Upper Chalk Formation, the cliffs being well exposed along the whole distance in a bold escarpment, attaining an altitude in some places of from sixty to eighty feet.

The most striking point observable in viewing these rocks from

*Formerly Bradstowe.

the sea, is the effect produced by the enormous wasting power of the waves. The whole line of the coast is deeply embayed, and exhibits a series of projecting headlands or promontories. In some places caves of considerable size have been formed at the base of the cliff, hollowed out by the constantly wearing action of each tide. These caves are apparently the cause of great masses of the chalk giving way at the summit of the cliff; large boulders of chalk strew the beach, and a flooring is formed in some places, by the consolidation of these masses: in others the rock falls in, and makes an inclined plane with the surface of the beach, sometimes ten or fifteen feet in height.

Almost the entire length of the coast at low water is strewn by large boulders of chalk; locally termed "the rocks," extending seawards for a distance of nearly a quarter of a mile; quantities of seaweed—fucus—and barnacles, adhere to these boulders, thereby protecting them from the force of the breakers.

On a closer inspection of the cliff, regular layers of flint are seen in a horizontal position, at intervals of from four to six feet apart,—parallel with the lines of stratification. Some of the layers obliquely intersect the beds of chalk. The shape which the flints assume is either tabular or rounded in the most fantastic forms, having filled up cavities in the chalk, and taken the form of these cavities.

* "The flat tabular flints, which are coincident with the stratification, are of a different age from the similar layers which are found filling cracks and joints. The former are contemporaneous with the chalk, and the flinty matter was deposited at the same time as the chalky matrix; the latter are, on the contrary, of more recent date, having been formed by the percolation of infiltrating water holding silica in solution, into cracks and joints which were formed in the chalk, during or after its solidification."

It may perhaps be needless to remark that chalk is nearly pure carbonate of lime, and may therefore be considered an earthy limestone.

Mr. Henry Clifton Sorby (the distinguished Microscopist), from an examination of thin slices of chalk under a microscope, has

*From Catalogue of Museum of Practical Geology, 1862.

found it to consist of from ninety to ninety-five per cent of the cases of foraminifera, and of comminated shells. Considering that the thickness of the chalk formation in England amounts to from six hundred to nine hundred feet, we are hardly able to realize the incalculable profusion of life which was required in order to build up such a vast thickness and superficial extent of material.

* * * * * * * * * *

A curious instance of marine denudation occurs at Margate, consisting of a detached mass of chalk about forty feet high, known as the "Fort Rock," (fig. 3.) Before this rock became isolated, the sea had made an extensive excavation around it, and at last the soil above it crumbled and fell. On visiting the spot this summer, I found the space from the edge of the cliff to the rock on all sides to be at least ten or twelve feet. This marine denudation offers a strong contrast to atmospheric denudation, the former produces jagged peaks, as in the Needle rocks at the Isle of Wight, the latter results in undulating slopes, such as the North and South Downs of Kent and Sussex.

It may not be out of place here to allude to the supposed former junction of England with the Continent; the following being the chief grounds for the assumption :—

Firstly.—The close resemblance in the chalk formation of the two opposite countries of England and France (which may be said to be continuous,) at Dover and Cape Griznez, for example, (*see map.*)

Secondly,—The extreme shallowness of the water in the straits of Dover—the existence of sand banks—notably the *" Goodwin Sands," where the chalk has been found by borings underlying fifteen feet of sand, resting on blue clay.

Thirdly,—The identity of the wild animals in historic times, such as the wolf, which infested both countries; and *lastly*, the discovery of fossil remains of the cave bear, hyæna, rhinoceros, lion,

*NOTE—An obscure tradition has come down to us, that the estates of Earl Godwin, the father of Harold, who died in the year 1053, were situated here, and some have conjectured that they were overwhelmed by the flood mentioned in the Saxon Chronicle, sub. anno. 1099. The length of this sand bank is about ten miles, by one and one-half in breadth.

tiger, and other tropical mammalia, not only indicating a warmer climate, but also suggesting the idea that these creatures must have found their way from the continent by means of an isthmus, which at that time may have united the neighbouring shores.

Subjoined is a list of fossils, and other specimens, from the chalk, collected principally near Ramsgate, in illustration of this paper.

Upper Chalk.

- Ananchytes ovatus.
- Diadema ornatum.
- Pecten nitidus.
- Terebratula subrotunda.
- Galerites albo-galerus.
- Ventriculitas in flint, (with Pyrites) and Selenite sulphate of lime.
- Spongia.
- Micraster, cor-anguinum, (in Chalk.)
- Ditto. (in flint.)
- Scales of Beryx ornatus (?)

At Pegwell Bay, the chalk thins out and finally disappears on approaching a low lying tract at the mouth of a small river called the Stour. The Thanet sand, a fine soft light colored sand, (the lowest member of the Tertiary or Eocene group,) here resting on the chalk, commences just below the surface soil; it is much crumbled by the sea, the debris being scattered about the beach.

Some of these masses hardened by exposure, act as natural breakwaters.

In many places, one finds in walking along the edge of the cliff, that the footpath has been remade several yards further inland, in consequence of large portions of the cliff having fallen in, and been rapidly washed away by the sea. In some parts of the cliff, close to the village of Pegwell, it has become necessary to build up the chalk with brick-work in order to prevent its further destruction.

Miniature landslips are very frequent, both of the chalk and the Thanet sand, dragging with them small trees and bushes growing on the edge of the cliff, strewing the shore with roots and soil.

Having ascertained that the coast line from Herne Bay (a place still retaining the name of a bay, although it is no longer appropriate as the waves and currents have swept away the ancient headlands,) to the Reculvers displays a good section of the Tertiary beds, I started off along the cliff, from the former place to examine it. For the first mile or so the cliffs shelved gently down to the beach, covered with grass and stunted bushes. Further on continual disintegration of the soft clay and sands (partly due to atmospheric causes), prevented the growth of vegetation of any kind except a few patches of weeds. Landslips of considerable magnitude are constantly occurring.

In one spot I noticed that at least a quarter of an acre of soil, upon which potatoes were planted, had sunk about ten feet from the top of the bluff upon which I stood; and now rested on a platform made by a previous falling in of the cliff. When about a mile and a half from the Reculvers I reached a deep gorge, (called Oldhaven Gap,) opening out on to the beach—the cliffs forming as it were the walls of the Gap, attaining an altitude of from sixty to eighty feet. At length I arrived at the venerable towers of "Reculver," and repaired to the "King Ethelbert" inn, to recruit myself previous to a return to Herne bay, along the sea-shore. A brief account of the past history of this interesting spot will, I venture to think, be acceptable to the Society, especially to those who are interested in the subject of Archæology.

"Reculver (Reculvium) was an important military station in the time of the Romans, and appears, from Leland's account, to have been, so late as Henry VIII's reign, nearly one mile distant from the sea. Some time before the year 1780, the waves had reached the site of the ancient Roman camp, or fortification, the walls of which had continued for several years after they were undermined to overhang the sea, being firmly cemented into one mass. They were eighty yards nearer the sea than the church, and they are spoken of in the Topographica Britannica, in the year 1780, as having recently fallen down. In 1804, part of the church-yard, (with some adjoining houses,) was washed away, and the ancient church, with its two spires, was dismantled as a place of worship." (*Sir Charles Lyell's "Principles of Geology," page* 312.)

I recollect as a child visiting the spot in 1850, and finding some human bones in the church-yard, which was then partly exposed on the sea-ward side.

It is said that King Ethelbert chose Reculver as his place of residence, and that he was buried there about the year 616. The church is now preserved as a landmark by the Trinity House, and being situated on a headland, it is a conspicuous object to vessels making for the mouth of the Thames.

As the tide was now ebbing, though slowly, in consequence of a very strong north-easter, I turned back along the beach in the direction of Herne Bay. A most interesting section was here exhibited of the superposition of some of the beds constituting the Lower Eocene formation. Fig. 1 shows the manner in which these Beds are disposed; and how much they have been denuded, particularly the Oldhaven beds. The greater part of the rock exposed to view between Reculver and Herne Bay consists of a yellowish quartzose sand, very friable, but becoming more argillaceous at the base; this is the Thanet sand. Large tabular blocks of indurated sandstone are interspersed at the upper part; these masses become detached from the parent bed and strew the beach, serving in some measure to retard the destructive progress of the waves. A water-worn pebble of this sandstone, coloured with iron, is exhibited.

Beneath the "Thanet sands" is a highly fossilliferous deposit, in which cyprina are met with in great abundance. These are so brittle that it is almost impossible to obtain a perfect specimen. The London clay is found capping these sands. It contains great quantities of concretionary nodules of an argillaceous substance, called septaria, which is in some places dug out of the clay, and used for making cement. Selenite, (sulphate of lime,) also abounds. Two specimens are shown, which I picked up on the beach, much water-worn; the larger one being an arrow-headed crystal, the characteristic form of this mineral.

The general appearance of the coast between Herne Bay and the Reculvers is remarkably picturesque. The large boulders of sandstone which bestrew the shore; the imposing height and broken aspect of the cliffs, with the surf dashing up, and loosening large fragments of rock, that come tumbling down amidst clouds of spray; all combine to form a wild and beautiful picture.

Tradition tells us that in times long past, the fields with their crops now on the verge of the precipice, were once nearly a mile from the sea; but every year, nay every day, is preparing for them a "watery grave;" and where the husbandman now guides his plough along the furrowed earth, the fisherman will some day (perhaps not far distant) be seen steering his little craft through the foaming waves.

N. B.—Reference is made in several parts of the foregoing paper to "Figures" illustrating various deposits; but it is hardly necessary to reproduce them.

Art. VI. On the Mammalia of Nova Scotia. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read February* 13, 1871.)

Lepus, Americanus, (Erxlebein, Shaw, Richardson, Dekay, Audubon, Baird.)
Lepus, Hudsonius, (Pallas, Bodaert.)
Lepus, nanus, (Schreiber.)
Lepus, Virginianus, (Harlam.)
American Hare, (Penant, Foster.)

The American Hare.

From measuring many specimens before me, the following are the least and the greatest measurement I have made:—

Length of body	17	inches.
Length to outstretched hind leg	24	"
Length of body	$20\frac{7}{10}$	"
Length to outstretched hind leg	$28\frac{5}{12}$	"
Length of hind leg	$5\frac{2}{10}$	"
Height of ear	$3\frac{5}{10}$	"
Length of head	$3\frac{5}{10}$	"

Their bodies seeming to vary more than their extremities. The smaller were doubtless the young of the year. In form they shew the usual leporine characteristics of arched forehead, high back and great length of hind leg, a crouching attitude when in repose with feet concealed; in swift motion a rapid galop of immense leaps, with hind legs thrown far behind; and in slow motion, the hind legs with the whole foot to the heel resting upon the ground. The colour of one before me snared 1st November, 1870, is, head, neck, back, and upper parts, sepia brown, with a yellow wash. At base these hairs are lead colour and covered by lead coloured fur. Belly white inside of fore legs, and fronts of thighs and legs to hind toes mixed white and brown. Inside hind legs white. Tail white, with mixed sooty hoary on the top, throat and fronts of forelegs yellowish brown, underneath the throat or chin greyish white. A dusky line leads from the tip of chin, emargines the nose and runs up to the forehead; there is also insideof this a white margin to the nose. Whiskers black, about four inches long. Ears outside fold or front brownish, the backs hoary, a narrow black edging on two thirds of the ears terminated in the broad black tip, the inside of the ear was furred about an inch downwards, giving a small white lining to the black border, the rest naked. The feet, both fore and hind, covered by thick, yellowish rusty fur. There were many coarse darkish hairs all over the back, and the base of all the hair either brown or white was lead colour. The eye was large and yellow, the nostrils frontal oblique, concealed by nose. Upper lip deeply divided to above insertion of frontal tooth with a naked membrane extending into nostril. The fore feet had four toes with a rudimentary thumb, the hind feet four. The toes both hind and fore are connected by a membrane to first joint and are densely furred. This, snared in November may be taken as a specimen of summer pelage, before the winter change. I notice that Baird describing the same hare from more southern specimens speaks of brilliant reddish or cinnamon tints. Ours exhibit none of those tints. Should I colour a drawing of one I should use sepia and cover with a yellowish wash. During the month of November, they change the brown tints for a soiled and rusty white. The following description from one before me, taken the middle of January, will serve as a description of the ordinary winter pelage.

Colour of all the upper parts, white soiled by rusty; the lower parts and hind parts, hair white as regards the belly, and soiled white behind. The hair or fur is much longer and coarser on these parts. All the fur both upper and lower is lead colour at base, that on the back is rust in middle and white at the tips. The nose and chin are always rusty; a rusty circlet usually surrounds the eyes, and the front folds of the ear is of the same colour. There is a streak of rusty down the front of fore legs, and sometimes on the front of hind legs. All four pads and feet are yellowish rusty. The tail is concealed by white longish hairs and the sooty spot on its extremity nearly concealed by them. The backs of the ears are nearly white, a black rim bordered by white and a black tip remains as in summer.

Thus in studying the changes, we find the white belly, the rusty pads and feet, and the borders and tips of the ears, remaining unchanged; all other parts turning more or less soiled white and the sepia brown changing into rusty. The variations in the intensity of this colour in different individuals, are only numbered by the individuals themselves. Some even in mid-winter remain unchanged, and again I have noticed two or three nearly white and stained by the sulphur wash so common in the winter weasel. But generalising, pure white below, rusty white above, and pads, nose, chin, circlets around the eyes, fronts of fore legs, and of ears, rusty, may be called the winter pelage.

On the first of November you scarcely see any change upon them except a little grizly on the forehead, or the fronts of thighs getting white. By December the change is complete. The change back again as the animal is not so directly under our notice is not so well known. However in mid-May, I have seen the forest filled by brown hares. Their gambols and attitudes reminding me of the maxim "as mad as a March hare." This, no doubt is their sexual season, and analogy would make us suppose they had completed their summer coating. As regards the nature of this change my observation leads me to suppose it is caused by casting the old hair and having it renewed by a new coat. The spring change undoubtedly is thus caused, and nature never employs two different causes. Those who maintain that it is caused by a sudden change of colour, must explain how the end of each hair is only changed, the base and middle remaining unchanged. In confinement it is said they never change. I have no experience in this but it is probably true, as I have seen, as before stated, individuals, unchanged in mid-winter. This hare is very numerous in our Province. Half-way in size to the Polar Hare, (*L. glacialis.*) which changes into pure white and which inhabits Newfoundland and Labrador to the Arctic circle, he is one half larger than the wood hare, which inhabits Southern N. England (*L. sylvaticus,*) and which never varies. Though our hare strays into N. England and is found near the Arctic circle, neither of these species are known with us. His habits are solitary and so vigilant or shy that you scarce put him up in the forest, yet the thousands that are snared for the Halifax market, or the new fallen snow, covered and crossed and recrossed by his tracks, attest his numbers. The hemlock swamps are his favorite places, in the bunches of the long tussock grass there abounding, he makes his simple form—his food the various grasses, and when he can obtain it, the tender twigs and bark of the white birch. It is a common practice to fell a white birch in the forest to attract them. The next morning the numerous tracks in the snow and the many victims, each snared in his treacherous noose, attest their numbers about, though you may have searched the forest around the day before, and unseen, solitary, vigilant, each hidden in his shallow form, not one would have met your view. The tender buds of the black poplar and the leaves of the pyrola are both said to afford them food. The female brings forth her young in May or early in June, from four to six at a litter. She is said to have two litters in the year in southern N. England; but here, judging from the size of the young, I do not think she produces more than one, though of this I am uncertain. Entirely defenceless, depending upon her extreme watchfulness for her safety, she seems an easy banquet spread for our carnivora. The crafty fox and sly lynx prey upon her. The great tree weazels, the fisher and the martin, hunt her down. The weazel winds on her doubles, and men and idle boys cross her path with snares, and yet nevertheless such is her fecundity and vigilance that she in her generations will see them all out. The number of sixty thousand skins collected by one man at Halifax, during oue season, attest her present number in the Province.

Such is our varying hare; our forests abound with them, yet only twice, except at the April meeting, have I ever met them. Once a half-breed dog put one up, and I had the opportunity of seeing two or three nice doubles, before she came into the open. Here the stupid hound ran headlong over her scent, and she escaped. Once again I saw one, near an old saw mill, sitting on her haunches, her long ears pushed forward, and fore leg hanging loose. In the April before spoken of, I stood upon a tussock of winter killed grass and counted seven that I could have tapped with my trout rod, and the forest all around seemed alive with their moving forms. Nothing but sexual instinct could have produced such a gathering. Usually she sits in her form in summer, brown as the dead grass and old hairs forming it, in winter white as the snow drift in which her tawny paws have scratched a hollow bed, in either place all but invisible, with her ever vigilant eye watching every object, her great pendulous ears thrown toward every vibration, and her soft feet ready for a swift and noiseless retreat. No wonder she escapes our observation, or that in the stillness of the northern forest we marvel where the hordes are, that last night left their thousand footprints on that feathery rime that covers the hard crusted snow, on each day's night of those brilliant sunny March days of our tardy Spring.

This ends our list of Rodentia, yet one introduced species must be added to it. The domestic rabbit (*Le cunicularius*,) which introduced about seventy years ago on Sable Island, suffered to become wild, and never recrossed by new individuals, has entered its feral state. They have grown larger in size and have almost entirely assumed a common livery of silver gray with white collar. They burrow in the sands of the Island, feed upon its rich grasses, and wild pea vines, and apparently live without water, as colonies of them live at least five miles from any fresh pond.

We come next to the Ruminantia, passing over the orders of Edentata, Solidungula and Pachydermata, of whom we have no representative in the Province except of the Solidungula, in the horse introduced into Sable Island some hundred years ago, and suffered to assume the feral state, and on which a paper has already been read before the Institute. Our ruminantia include only two individuals, but they make up for their fewness by their beauty, and the majesty of their antlered proportions—the Cariboo and the Moose deer. We cannot refrain from some few generalisations arrived at in the study of a boreal fauna. We find animals of the most opposite construction, braving a northern winter. It is not as if there were animals fitted for the pole, and others fitted for the equator, but as if both kinds were mixed together and tropical forms live beside the arctic. Thus we have the marmot, a true boreal form protected from the cold by hybernation; and the mouse a cosmopolite but with the thin coat and naked leg also protected by hybernation. We might say this is his natural protection, unable to endure the cold he sleeps through it; but we are met by the fact of the shrews with still finer coats, and limbs so fragile that they seem needles, bearing the lowest temperature, active and nimble, beneath a thermometer of —15 degrees. The beautiful red squirrel sports with his naked palms on snow, standing at the same low level, whilst the ground squirrel is fast asleep in his well lined burrow. We are apt to say of the ermine and sable that their thick lustrous fur, well covered pads and ears, and strong carnivorous diet enables them to endure the low temperature in which they delight, yet we have side by side with them our spare vegetable eater, the hare with its long naked pendulous ears, (apparently the very subjects for frost bite) sitting in its snowy form, whilst they have sought their burrows. Thus, though it is very true the furry foot of the great day owl and winter falcon, of the northern lynx, and the isatis, of the ermine weasel, ptarmigan, northern grouse, and polar hare, are the true livery of the north, yet we find animals equally bearing it with naked limbs and thin coats. It seems that something akin to what geologists say has taken place in the physical world, has also influenced the animal one. As the gorgeous tropical flora of the carboniferous period, attest to the sunny days once ruling at the arctic circle, so too may the fauna have been equally disturbed, and have left the remnants of their races behind them in times far subsequent to those stony records.

No true boreal forms exist at the equator, and these remnants of equatorial life, if they be such remnants, seem endowed like man to retain life in every degree of cold or heat.

Since the above paper was read Mr. Welch, the asst. surgeon, 22nd Regt. has sent the Institute a paper read before the Zoological Society, London, April 8th, 1869, entitled "Observations on L. Americanus, especially with reference to the change of colour, &c." In this very able paper the writer concludes that the change of colour is gradual, taking about seven weeks, and is caused by a new growth of white hair, and also by the summer coating becoming white on its tips as well as thickening as regards each hair, the cause being the suspension of the secretion of the *Pigmentum nigrum*, and that there is no shedding process going on. I have thought it best not to alter any remarks I have made, but to make further observations, no doubt caused by reading Mr. Welch's paper. He has studied a much more boreal animal than ours. His changes take place in October, ours in November. He speaks of a pure white with leaden base, our animal never reaches this; a rusty white in mid-winter is all ours attains to. Our nearness to the ocean causes our climate to approximate to southern New England, where the hares become in winter only hoary. Mr. Welch has the credit of publishing the first original, exact, and exhaustive articles on change of colour caused by climactral influences, ever given to the public. My observations were made from the Halifax markets, which are abundantly supplied with hares. Beginning the 18th October, I found one with two white whiskers. On the 30th I found one with a whisker half white and half black, but in no other respects changed. On the 9th and 10th November, I examined many more, one had hair in front of thighs getting long and white, several more had the same appearance on fronts of thighs, but in addition, the rump and tail becoming covered with long and white hairs, a white patch each side of the nose, a patch upon the forehead and backs of ears becoming hoary. One had a patch of white running up the side of the belly, in front of thigh. The whiskers were generally white. November 18th a very large buck hare, had forehead to the eyes white, spot middle of forehead and back of eyes white, backs of both ears and stripe running down nape of neck, white. Some white and long hairs in front of fore legs, (which are also becoming rusty) and shoulders with long white hairs, the hind legs, with exception of toes and pads are soiled white, this soiled white has invaded the whole rump tail and is creeping over the hind flanks and down the back to about two inches. Under a strong glass, this soiled look is caused by long black hairs scattered about. The brown fur still remaining is short and lustreless, still having many black hairs through it, and the edges ill defined where it borders upon the white. The toes both before and hind are light rusty, and all the pads, rusty white, and much thickened in patches; on opening the fur on the brown parts and examining it with a strong glass, the basal fur is seen, and through it a short crop of white hairs, sticking up and crossing each other in all directions is seen. In the pure white of the belly and where the change has taken place, this crop is not seen. Every where the long white hair is thicker than the old brown hair which comes out on pulling, about as easily as the new.

In this specimen, is a short crop of white hair, new long white ones, and many long black ones, both in the changed and unchanged parts. The light rusty streak on the fore arm, fore and hind toes, is not I fancy a new colour gained, but caused by the absence of the numerous small black hairs which in summer sprinkled upon these parts give a sepia brown to them, but being absent a light rusty colour pervades them.

27*th November.*—In this specimen the long winter coat had pervaded the whole animal: pure white below, soiled or rusty white above, especially upon the dorsal ridge. The nose and about the eyes rusty; the ears hoary rust; the front folds deeper rust. The tip of the hairs white, the middle rusty, the base plumbeous. The back had still a soiled black look, which under a strong glass, was caused by numerous black hairs about two inches long and black to the roots. The whiskers are some black, others black at root, and white at tip, others all white. The pads hind and fore are of a deeper rust, and longer and thicker; the toes both hind and fore, light rust. Under the glass the short black hairs which in the summer specimens are numerous in these parts and causing the brown sepia tints, are very few. The same cause is making the fronts of the ear rusty. Though this specimen which was a large buck had so nearly completed his winter change, yet I had to search some fifty specimens, all in the earliest state of change, before I could obtain it—the mildness to this date, of the winter, causing them to change slowly. In a specimen taken aboot 21st January, that is mid-winter, there was a little rusty colour on the nose, about the eyes, on the front folds of the ears, nape, chin, fronts of legs and toes both hind and fore, and heels, the rest more or less, white; the belly, fronts of thighs, and rump, had long loose hairs, plumbeous at base, white at tip; the dorsal parts had shorter hair, plumbeous at base, rusty in middle and white at tip; this middle rusty, continually showing through the white tips gave the animal a soiled rusty white appearance. All the long black hairs of summer have disappeared; the bright rust of the legs, far brighter than any summer tints, is produced by the absence of the short black hairs, which in summer toned these parts down to a sepia brown; the whiskers are black. I think the change in this may be considered complete except the whiskers. I have noticed other specimens where the sides and dorsal regions were mottled white and brown on the whole surface instead of changing in patches.

From these observations, we gather that the first appearance of winter change occurs in front of thighs, and rump, that almost immediately the backs of the ears become hoary, and white patches appear on the sides of nose, cheeks and forehead, and that whilst the white of the rump is stealing over the tail and up the back, the white of the belly is rising to meet it, and the patches of white are stealing over the face, the nape and fore shoulders; that in some comparatively rare instances a general mottling of white and brown takes place, instead of these regular approaches. The hare in his full winter coat in Nova Scotia is pure white beneath and on thighs and rump; rusty white on dorsal regions; nose, around the eyes, front folds of ears, fronts of fore legs and hind legs, light rust. The pads and the narrow black edge and tip of ear remains unchanged, the pads being soiled white or light yellow. On the dorsal regions the hair is plumbeous at base, rusty in middle and white at tip; beneath thighs and rump, longer and plumbeous at base with white extremities. With regard to the secondary cause of these changes but little can be found in systematic writers. Mr. Welch attributes, in his able paper before mentioned, to first a new growth of long and thicker white hair which as it were out-colours the brown, and to a change of colour in the remaining brown to a pure white with plumbeous base, and that no shedding takes place. From his description he has studied more boreal specimens than ours, since he calls the animal pure white. Whilst he has the analogy of the whiskers, which we know do not shed, and which we study from time to time, now all black, now the tip white, now all white, and whilst there comes to us a certain conviction we are studying the same individual hairs, yet in other animals which we have watched more closely there is an autumnal change. Our horses as everyone knows, who rides them or inspects the stables, have a large autumnal shed, a strawberry roan especially an old one, will have broad patches of hoary on his rump in mid-winter. The cariboo sheds by handfulls in November, as also does the Virginia deer. The very bright rust on the fore legs, caused under a a strong glass by the absence of minute black hairs, existing in the summer coat, can only be accounted for by shedding. In the few polar hares I have studied, from Labrador and Newfoundland, the entire animal is pure white except edge and tip of ear black; a very faint rust on the fore arm just points to a semblance with ours. The summer pelage is a beautiful pencilled French grey, with the entire ear of a velvet black, at least that was the colour of a skin from Labrador.

The Cariboo.

Cervus tarandus, cariboo, (Linn., 1792.)
Rangifer, cariboo, (Aud., Bachman, Baird.)
Cervus, tarandus, (Godman, Harlam.)
Rangifer, tarandus, (Dekay.)
Cervus tarandus, Sylvestris, (Richardson.)
Tarandus, rangifer, (J. B. Gray.)
Cervus, hastalis, (Agassiz.)

From these synonyms we learn that the doubt still unsettled, whether our Cariboo and the Lapland Reindeer are identical, commenced with the great father of the science, Linnæus. That there should be seven or eight synonyms since his day, and that such men as Dekay should call him *Rangifer tarandus*, and J. B. Grey of the British Museum, *Tarandus rangifer*, and neither accept Linnæus' specific "Cariboo," argues little for that simplicity of nomenclature now so greatly needed. It would go a great way to solve the doubt, if a thorough and scientific description of our cariboo could be made and recorded; but for this at present I have no materials, and so seldom now have we the unbroken deer brought to town, I fear years might elapse. The following description from my recollections taken from one live one, and the carcasses of many dead ones must suffice:—

A full grown cariboo stands about three or four feet at the withers, the doe something less; the head is large and narrow, the forehead having no dish in it, but straight, the lower line also straight; the muzzle entirely hairy. We miss the wide swelling forehead, the elegant curve and pointed muzzle of the more southern deer; the neck is short and carried low with the hair long and flowing on its lower surface, the back rather straight, powerful loins and haunches, body heavy and supported by stout and thick legs, and large wide spreading hoofs of the blackest dyed horn.

The animal stands with its weight resting upon the dew-claw, or back hoof. Thus we see an arctic type; strong, low, broad, fitted for fatigue, living in low, ever-green woods and swampy barrens in summer, in winter running freely over the snow. Both sexes have horns, the doe comparatively small; with great irregularity of form, those horns are all regular in two or three typical marks. They have almost always one brow antler, broad and palmated over the eye, the other corresponding antler round. A second brow antler fronting forward, a few inches above this; and the main shaft of the horn turned forward, more or less palmated, and with more or less tines, all coming from the back or convex surface of the horn. I possess a pair of horns, in which the two brow antlers are symmetrical, resembling clasped hands over the forehead. I possess another pair of very small horns, with one simple brow antler, and but one tine from a scarcely palmated horn. This last came from Labrador, and I think is a doe's. The other may be either a Nova Scotian or Newfoundlander.

Between those two, which may be considered the ultra extremes, the variety is endless. The bucks cast their horns in January and February, the does retain them a month or so longer. The colour varies in summer and winter; the winter coat, that which I am most familiar with, is thick and long, of one prevailing soiled yellowish white. The hair on the neck, breast and belly, rather whiter than on the back, and the rump and tail white. The legs on the outside are brownish, and have a fringe of white hair over the instep, and extending to the back hoofs. In summer, towards July, this thick soiled white coat is removed, and in its place a fine clove brown, sometimes bright yellow brown (according to Captain Hardy) on every part, save the neck and shoulders, rump, tail and belly, with inside of the legs which are white; the ears brown and forehead white. Mr. Eagan informs me that in a September skin he saw, the line between the white and the brown was well defined;

those I saw myself I took no notes of. In Captain Hardy's (an accurate observer) sketch, the whole neck is represented white and long haired, but not reaching behind the shoulders; whilst in Sir Wm. Jardine's coloured drawing of the Reindeer, the white extends far backward to the quarters. Audubon also mentions a faint white streak behind the shoulder. The legs of a doe killed in September were beautiful mouse colour, with a wash of dun. James Luxy, (Alexis,) an Indian hunter, says that when the does have fawns, that is July or June, they have a black ring about their eyes, (Hardy's black patch on the cheek,) and also the white of the neck extends farther upon the side. (Sir Wm. Jardine's coloured sketch of Reindeers shows this.) Of two legs with hoofs before me, killed winter 1871, the colour is deep brown, I should use sepia in drawing it, with a white fringe around the coronet, running back to beyond the dew claw. Thus in summing colour up: In winter, soiled yellowish white; neck, rump, tail and under parts, pure white; legs white inside, outside brown, with white fringes. In summer, neck extending into fore-shoulder, rump and tail, under parts and inside of legs pure white, all other parts clove brown; sometimes reddish and yellowish, with black patch on cheek and eye, and white fringe on hoofs. In colour then our own Cariboo assimilate closely to the Lapland Reindeer.

In studying the hoof before me, nothing can exceed its beauty of finish. The inside a perfect cavity, the frog all absorbed or dried away, the outside rim with a beautiful cutting edge. The animal must stand almost like a woman upon pattens, on four rings, upon any hard surface, in descending slopes, the dew-claw behind would bear slightly on the surface. The whole too is enveloped in a beautiful fringe of coarse hair, curling down over the black hoof till it nearly covers it, and passing between the toes to form a thick mop of coarse hair, wrapping the sole and dew-claws in a warm cushion. On glittering ice or slippery slopes how secure this ice foot, with its keen circular cutting edge; in soft snows, spreading the toes it forms a broad cushion to hold up the deer upon its treacherous surface, as well as to shield it from the cold. We are immediately struck with an analogy most unexpected between the hairy foot of the deer and the feathered leg and claw of the winter falcon, and great northern owl; and we are apt to speculate how the deer, passing north, has had his limbs thus clothed in hair, and has departed from the typical slender, satin-skinned foot of his race. Yet geological facts deny the assumption; they teach us that once there was a world that produced nothing but bitter lichens and sour mosses, scantily growing beneath winter suns, and upon glaciated wastes, and that there came a thick-legged robust deer to browse upon these mosses, with his thick coat and hairy hoofs, the first type of deer the world ever saw, the companion of the U. speleus, the cave bear, the extinct hyena, the rhinoceros, terchoorinus, and the primordial elephants, all extinct but himself; so runs the record of the geologist, carried out in his stone-flora, and by the bones found in the upper tertiaries. How far the earth's surface was thus covered is conjecture, perhaps near to the equator. As genial suns under a better climate produced more exuberant crops, this arctic species gradually retreated from the pole. In Europe, he has retreated to Lapland; in Asia, to the shores of the Arctic ocean, where herds are kept by the Tungeses; in America, a few are left in Nova Scotia; more in Newfoundland; and the rest are all driven back toward the polar circle.

Nova Scotia, with its latitude between 43 and 44 north, is their lowest southern habitat now existing, and consequently the most interesting place to study them in. The following are the dimensions of a buck killed this winter, in Digby county, by my son; they were taken upon the spot, thirty miles from the sea, marked upon his waist-belt, and carefully taken off on returning home.

Length from tip of nose to tail,......	7 ft.
Height at foreshoulder,.......	4 ft. 10 in.
Girth at foreshoulder,......................	6 ft. 4 in.
Girth, thickest part of neck,................	3 ft. 7 in.
Length of hind leg, from hip,.	5 ft. 5 in.
Length of fore leg, ...	2 ft. 6 in.
Girth of hind leg, largest part, ...	1 ft. 2 in.
do do smallest part,..........	7 in.
Girth of fore leg, largest part, ...	1 ft 1 in.
do do smallest part, ...	6 in.
Tip of nose to ear, ...	1 ft $8\frac{1}{2}$ in.

He had no horns.

These dimensions are enormous, but are fully carried out by Captain Hardy and other authors, though doubted by Sir John Richardson, who, accustomed to the Arctic variety, weighing when dressed sixty pounds, and which the hunter tossed over his shoulder, thought a cariboo weighing four hundred pounds must be a mistake for another species of deer. I have now given his appearance, colour winter and summer, structure of hoof, his weight and dimensions, and in this have rather shunned authors, but taken my own and the observations of eye witnesses. The only one I have seen living was a young doe without horns; she was of the soiled white or winter colour, and resembled Bewick's wood cut of the Lapland reindeer, and also Landseer's exquisite etching of a cariboo's head, after Captain Back, (*Fauna Borealis.*) The plates from "Mammals of Zoological Gardens," and of Sir Wm. Jardine, copied by all writers, though no doubt good representatives of reindeer, were less like her.

It now remains to give a sketch of his habits in our own Province. Formerly very abundant, and in our own time plenty, as the skins brought to market some fifty years ago showed; but few skins and scarcely a carcase of meat in one or two years finds its way now to town. Therefore if they are becoming extinct, it is not by the hand of man. When I lived in the western counties, a year or two would elapse before one was killed; we have no wild animals which destroy them; wolves, happily extinct, are the only ones to be dreaded. If then they are becoming extinct, it must be by that noiseless way that wild animals fade out of sight, as their feeding grounds become encroached upon; they lose their reproductiveness, the doe has fewer fawns, the buck becomes early barren, the devoted race dies out. Now, the food of this ancient deer exists as it did in Pleistocene times, perhaps on the very spot, but in less abundance. Forests have sprung up, and grasses have given verdant carpets to a warmer soil; the lichens and mosses his food, (*Cladonia rangeferina*) (*Sticla pulmonaria*) (*Usnea*) are now found in isolated barrens, or cariboo bogs as they are termed, and they are every year encroached upon. The great cariboo bog at Aylesford, the water shed of the Province, has a rail road running for five miles on its surface. The table land of the north mountain, from Blomidon to Brier Island, once a favorite resort, is now become strange to them; a part linger about the Cumberland hills, the lake basin of the Shubenacadie, the St. Mary and the Tangier hold a few more; Margaret's Bay and the basin of the Avon might shelter a few, and finally the great western lake basin, and barrens from whence flow the Annapolis, the Sissiboo and the Bear into the Bay of Fundy, and the Liverpool, Shelburne, Clyde and Yarmouth, into the Atlantic, is their last hold. Accustomed in ancient days to roam the Province, this restless, wandering creature, is confined to those isolated spots, where he scents the tainted gale of man, or hears his axe on the down wind, and with a snort seeks a deeper solitude, if haply one may be found; this must go far towards his extinction. Thus our cariboo may be said to range in those different lake basins, in herds of from two or three to seven or eight; the does to produce their young in June; and the rutting season to be in September. It is rarely that they are killed in summer or fall, unless accidentally seen on the barren and stalked. It is impossible to track them in summer woods; on the winter snow he leaves a wide track, and though from his fleetness in running over the snow, on which his broad foot holds him up, it is impossible to chase him with snow-shoe and dog, yet he may be stalked silently, and come upon within a hundred yards to windward, whilst pounding the snow with his fore foot from above the lichens. The following is a brief hunter's diary, sent me fresh from the spot:—"We struck the tracks on a barren; they were a day old; followed them about two hours; then came upon them on a barren, digging the snow with their feet, to get at the mosses they feed upon; they were in plain sight for five hundred yards either way; crept up to within one hundred yards, and missed them; they ran right towards me; killed one at forty yards; as they ran by me killed another at one hundred yards; still running killed a third at two hundred and fifty yards; at four hundred yards fired and missed; still again at five hundred yards fired and missed." Thus here were six shots, and five loadings, from a single barreled breech loader, whilst the deer were going five hundred yards. The last two shots, fired from a single Enfield breechloading rifle, may be considered forlorn hopes, sacrificed to the love of sport, as few marksmen are good for running shots, at four and five hundred yards; yet considering the cold, and the position covered by snow, the firing was rapid.

As the question now stands, Nova Scotia has a deer identical with that of Newfoundland, Labrador, and what may be called the southern limits of the polar circle, but larger than all. Lapland and the north of Asia also possess a deer, supposed, but not identified, as the same species, both smaller than ours. Reindeer, cariboo, and woodland cariboo, 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 cariboo. The absence of the gall bladder seems a very great divergence; yet can any one tell me has our own cariboo one? The horse we know has none. Finally, bones found on the upper tertiary of this ancient deer, and also in ages long subsequent, in the kitchen middens of the pre-historic man of the old world, as well as in our own of more modern date, undoubtedly prove him to have lived side by side with forms that have forever perished; again to have been the food of man of the stone age, who crushed his bones and tore his bloody flesh with their rude axes, where now their polished descendants carve in silver and steel, and which pushed backwards to the snows and lichens of the Poles, affords still the same rude banquet to the man of stone of the nineteenth century. Most enduring form, most ancient type of all deer extant, this broad-spreading, hair-cushioned foot, with its cutting edge, how many forms has it survived, how many new forms born of itself; of satin-skinned deer, with pointed toe; or African sun-dried deer, with hoof a nut-shell—has it seen.

RECORD OF OBSERVATIONS ON THE GEOLOGY OF NOVA SCOTIA, SINCE 1865. BY REV. D. HONEYMAN, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

IN the spring of 1869, I surveyed for the Geological Survey of Canada, Middle and Upper Silurian and Lower Carboniferous areas underlying the Pictou Coal Field. I commenced operations at Springville, East River, Pictou, where I had already spent no small amount of time. I now succeeded in extending the known area of Silurian rocks very considerably, and in developing the structure of this very interesting field. I advanced the Aymestry limestone rocks with their fossils into the river, and found them overlaid directly by black lower carboniferous limestone, as in Holmes' Brook: *vide* Acadian Geology, 1st ed., p. 243; 2nd ed., p. 316. Here we have the upper silurian and carboniferous limestone in contact, without any strata intervening, as at McAra's Brook, Arisaig, shewing that these upper silurian rocks were exposed at the bottom of the sea of the carboniferous era, when the limestone was formed upon it. I shall yet have occasion to notice other cases of a similar kind in this district. I have not observed similar occurrences in any other part of the Province. I also extended the same lower than formerly, by finding Arisaig Medina sandstone fossils in an old clearing N. of late Rev. A. McGillivray's, underlaid by a band of quartzite, which is possibly the Arisaig Oneida conglomerate. This is the only locality where I have succeeded in finding this formation out of Arisaig.

The extension (?) of this Oneida conglomerate and Medina sandstone underlies the limestone (new ore) bed at Fraser's, one mile and three fourths above Springville Presbyterian church. The ore being included in the Clinton, between the formations just mentioned and the Niagara limestone equivalent. This series has been thrown into its present position by a great dyke of greenstone, which is seen outcropping largely a little farther up the river. On the other side of the river, S. side, are lower carboniferous strata, having a considerable breadth of gypsum funnels. These extend to McDonald's Brook, a small branch of East River, where lower carboniferous sandstones outcrop. A continuation of these near Springville, opposite the Bridge above Springville, shew a considerable area of gypsum, with a continuation of funnels; all to the S. of this is lower carboniferous.

The greenstone is homogeneous and ferruginous. It lies in the axis of an anticlinal, which for convenience I shall designate anticlinal No. 1. On the opposite side of this anticlinal, I found the lowest strata highly metamorphic, and at the point of contact coalescing with the greenstone. The Clinton slates above these are well exposed in the Brook that passes immediately E. of the Presbyterian Church. I did not find any fossils in these slates. The other strata are covered by forest, until we get to Blanchard, in the vicinity of the bed of fossiliferous iron ore, referred to in Dawson's Acadian Geology, last ed., p. 591. In John McDonald's hill, I found lower Helderberg strata with their characteristic fossils. These appear to be the uppermost strata of this other side of the anticlinal, and corresponding with the lower Helderberg of Springville, which I have already noticed. Situate in Blanchard, and nearly opposite McDonald's hill, with its outcrop of fossiliferous lower Helderberg strata, is the bed of fossiliferous iron ore referred to. This evidently lies in Clinton slate, having a high dip. This series forms a synclinal with the preceding series; below the bed of ore are strata which I conceive to be the equivalent of the Medina sandstone. These are highly metamorphic,—the lines of stratification being occasionally exhibited by weathering, and by beautiful banded structure.

Below these is an outcrop of homogeneous and ferruginous greenstone. The preceding strata are finely exposed in a brook which, issuing from Blanchard, enters East River. The exposure forms a bold section, with a fine waterfall. The greenstone last mentioned proceeds onward parallel with the exposure of strata, and in the rear of it, widening as it proceeds, and ending in lofty mountains, having their termination at East River.

I would designate this greenstone as axis of anticlinal No. 2. Near the point of contact of the slates and greenstone, where they terminate near the river, is a considerable deposit of lower carboniferous limestone, lying on the middle silurian slate, and coalescing with it, forming a breccia. Connected with this is a band of green pyritiferous marble, which is exposed on the bank and in the bed of the river, beside a bridge, and near the mouth of McDonald's Brook, which enters from the opposite side. I shall have occasion to refer to this brook again.

Proceeding farther up the river, I found at Kennedy's, on a road to Blanchard, a small outcrop of breccia, having limestone like a paste, with angular pieces of metamorphic argillite. This outcrop was about twenty paces in length, occupying an elevated position in contact with the greenstone of anticlinal No 2. Starting from the breccia and skirting the greenstone according to the course of the river, we come to Squire McDonald's, and find above his house the termination of the greenstone, and below his store, on the bank of the river, an exposure of a band of lower carboniferous limestone, which, above the bridge of Pleasant Valley, forms a wall on the opposite side of the river, and re-crosses the river, where we shall meet it again.

Returning to Blanchard, I find the bed of fossiliferous ore to be of considerable thickness—forty feet or thereabout—and extending the length of McDonald's property, but not beyond it;—a supposed extension of it northward being an outcrop of reddish slate. Passing over to the other side of axis No. 2, I found, beyond an interval between the greenstone on the other side of Squire Campbell's marsh, a fine outcrop of slate, with abundance of crinoids, and a Dalmania Sp? characteristic of the Clinton of Arisaig. Proceeding onward to East River from this point, I found another outcrop of similar slates. I saw several outcrops of slates, but did not particularly examine them. They extend to a brook which enters East River, near the bridge at Pleasant Valley. They outcrop at the mill dam and up the brook for some distance. I now come to notice the relation that the band of limestone which I described as forming a wall on the opposite side of the river, bears to the slates that underlie it. The river separates this wall from the strata of argillites which are finely exposed on the side of the river opposite to it; i. e. on the north side of the river. Proceeding along this side of the river I pass five exposures of slate, and at last come to the place where the limestone re-crosses the river. Here I find them overlying metamorphic argillites, without any other rock intervening. These have all the appearance of lower Helderberg argillites, much altered. I found no fossils in them. Their cleavage joints glistened with micaceous iron ore.

These limestones extend to the bank at widow Chisholm's and disappear. The last outcrop of limestone occurs about a mile farther up the river, and above the road. This appears to be the extreme of the carboniferous formation in this direction. The band of silurian strata which underlies the limestone below Chisholm's, is underlaid by greenstone. The line of contact is cut by the road that leads from the Presbyterian church to the Blue Mountain. The greenstone is very long and wide. I do not know its boundaries. It extends up the river to the rear of the last outcrop of limestone. This greenstone belongs to an apparent monoclinal series. Farther up the river, at McPhee's, I found another outcrop of strata with greenstone. This may be called anticlinal No. 3. From this the silurian area becomes divided and bifurcates; one branch being what I have traversed on the one side of the river, and the other extending on the opposite side; the two being separated by the narrow lower carboniferous area, to which the limestones that I have already noticed belong.

I examined the skirts of the silurian formation on this the south side of the river. I found the first outcrop in the bed of the river, south of McPhee's. The strata exposed consists of black shale, which appear to be near the lowest part of the Clinton equivalent of Arisaig. Farther west the same strata are exposed in a brook at the dam of a saw-mill. Farther west they are again exposed in a brook at Pleasant Valley, with an underlying band of lighter colour and greater solidity, which appears to resemble the Medina sandstone equivalent of Arisaig. Still farther west we reach McDonald's brook, to which I have already called special attention. This is opposite the green marble, which I referred to as connected with anticlinal No. 2. In this brook there is a great exposure of the strata under examination, and in addition to these a series forming an anticlinal, which extends to the distance of two hundred and fifty paces from the river, making the greatest possible breadth of the intervening carboniferous band very narrow. In this side of the anticlinal, I found strata containing Clinton fossils, which enabled me to determine the equivalency of the corresponding strata on the south side of the anticlinal, which include the *specular iron ore* at McDonald's. By this discovery, I was enabled to establish a geological connection between this ore of iron and the *fossiliferous iron ore* at Blanchard, and the *limonite* (iron ore) of Springville. In the axis of this anticlinal I observed a mass of greenstone on the left of the road which leads to McDonald's. These strata are farther exposed on the side of another brook below Archibald's. From the green marble the carboniferous area widens and expands as it proceeds westward; the silurian proceeding westward until we find it cut by the Pictou and Truro railway, by which the fine section of the strata is formed, which I have already compared with sections of the strata of the Gold Fields.—*Vide* Part preceding.

Returning to Springville, I proceed to describe my operations in extending farther the knowledge of the geology of this district. At McLean's I found the limestone separated from the lower Helderberg, by a band of lower carboniferous shale. This occupying the position which I have found limestone occupying in Holmes's brook; in the river at McPhee's, Springville; and in the river at Chisholm's, Pleasant Valley. This shews that clay was being deposited, as one might expect, on upper silurian strata; while limestone was being at the same time formed upon the same kind of strata; so that the two must be regarded as contemporaneous. I succeeded in extending the lower Helderberg to the north of McLean's, as far as the extremity of Irish Mountain. I found fossils of this horizon at McMillan's, and near McKenzie's, *in situ*. At the foot of Irish Mountain, at McMillan's, I found the lower Helderberg overlaid by lower carboniferous conglomerate. This outcrops in the drain on the side of the main road, and in the little stream below McMillan's. On the back of Irish Mountain I found fossils *in situ*, but not very distinct; and in Cross Brook, behind it, I found Clinton strata, with characteristic fossils. I followed these down the brook, where I found them extending to the north of Irish Mountain and its lower Helderberg, resting on the greenstone, a continuation of axis No. 1, and overlaid unconformably by lower carboniferous grits and limestones. I found also the greenstone extending into the lower carboniferous formation, some distance beyond the silurian strata. The northern extremity thus ends in the lower carboniferous of McLellan's brook, while the southern ends at the southern carboniferous of East Branch, East River;—the length of the axis being six and a quarter miles. The 1st part giving direction to the series of silurian strata, as far as Holmes's Brook, Springville; the 2d giving a different direction as far as McLean's limekiln, or rather McIntosh's in the rear of McLean's; the 3d giving direction to the remaining strata of Irish Mountain and Cross Brook. Returning to the part of Cross Brook which is in my line of section, from the gypsum on the west side of Irish Mountain to Sutherland's river, I crossed the Clinton strata until I reached McDonald's, senr., where I found an outcrop of Medina sandstone, with its characteristic *petraia* considerably altered, resting upon greenstone of axis 1. Here the area of the outcrop of greenstone is considerable, being about two hundred paces across. Then comes a wide band of metamorphosed strata, corresponding with those of the other side of the anticlinal, but much altered, and to all appearance destitute of fossils. These extend lengthwise, and terminate partly on a mountain east of the northern extremity of the axis; part pass over McLellan's brook into the mountains, called McLellan's Mountain, forming the western side. Against the back of these silurian strata, lower carboniferous grits and limestone rest. The junction is seen in McLellan's brook, above Fraser's. In this lower carboniferous area lies the thick band of limestone on which the house of the late Rev. Dr. McGillivray is built, and also an outcrop of black limestone at the Cross Brook bridge, near McGillivray's. Some distance from this junction of lower carboniferous and middle Clinton (?) strata, or about three quarters of a mile, as the crow flies, is a fine section of strata, on the site of a saw-mill, having abundance of lower Helderberg fossils. I was rather taken by surprise when I came upon this fossiliferous outcrop, as the character of the underlying strata did not lead me to expect it. This fossiliferous band is exposed about the length of the eighth of a mile in the bed and on the sides of the brook. It assumes the form of a syncline. Part of it, therefore, belongs to another series of silurian strata. This outcrop is doubtless an extension of the lower Helderberg of Blanchard, on McDonald's Mountain.

I sent a collection of fossils from this locality to the museum of the Survey. This new series of strata, of which the lower Helderberg part is exposed, enters into the formation of McLellan's mountain. Simon Fraser's mountain shews an outcrop of greenstone in the line of axis No. 2. This line then runs in a south east direction, having first one outcrop of greenstone with red porphyry, and then two other outcrops; and then it is possible that there is no other outcrop until Blanchard is reached. Parallel with this line is a fine exposure of Medina sandstone strata, overlaid by Clinton shales. On the side of the road ascending the mountain named, I was very fortunate to find a mass of rock having abundance of characteristic *petraia* and trumpet-shaped cornulites of Salter's Report, and an organism which I did not recognise, but which I considered to be possibly the pygidium of a trilobite. In similar positions I generally find the petraia in the form of casts—internal and external. Here I find the organism itself, as I get it on the shore between Doctor's brook and Arisaig. I also found other specimens throughout the outcrop, but they were by no means so abundant as my first success led me to expect. I did not find any in the Clinton strata of this band. These are doubtless an extension of the strata of Blanchard, containing the bed of *iron ore*.

I did not find fossils in any of the other strata between this and the fossiliferous lower Helderberg of McLellan's brook. However it is something to have characteristic fossils from the highest and lowest parts of a series. I found the greenstone of axis No. 2 also exposed in the church yard, near the Presbyterian church of McLellan's Mountain, and two considerable outcrops still farther north, having an extension of the Medina slate of Simon Fraser's mountain. West of these is a considerable outcrop of slates, which probably belong to the other side of the synclinal. These are succeeded in the same direction by conglomerates, containing a dyke of greenstone. It is quite possible that these may be a continuation of axis No. 2, farther north, as I have not examined in that direction.

Returning to the greenstone of axis No. 2, on the line of Simon Fraser's mountain, we ascend to the summit, and find outcropping the strata of the other side of the anticlinal. The numerous outcrops shew that this band is of considerable width. These outrcops also extend in a northerly direction, and run up against or to the east of Wier's mountain,—the most northerly outcrop being in David McLean's brook. The distance between the two extremities of this anticlinal being nine and a half miles. These strata are all metamorphic, being apparently destitute of fossils. To the north of the extremity of second anticlinal, lies the lower carboniferous, having an outcrop of limestone. This is situate on the north side of a little brook at the seat of a saw mill. The lower carboniferous strata are not seen in contact with the underlying silurian strata.

The general direction of the two anticlinals that I have described, is north-west. The next in order takes a different course. I have said that the last outcrop of the eastern side of anticlinal No. 2, lies to the west of Wier's mountain. This mountain is a great mass of greenstone, being apparently bounded on the north by carboniferous conglomerates, &c. The axial line of this mountain takes a direction north east; while the axis No. 2 has a north west direction. On the south east side of the mountain, not far from Mr. Wier's house, there is an outcrop of metamorphic silurian strata, which are undoubtedly the Medina sandstone equivalent. These have a north east strike; they are continued onward in the same direction, outcropping on the lower side of an old road, and then they terminate at Sutherland's river, forming a somewhat imposing fall, which has been made the seat of a factory. Overlying these, unconformably, are lower carboniferous strata, conglomerates and grits: these are well exposed in the river. The carboniferous formation comes up against the lowest part of the silurian strata. We have thus reached the extremity of the lower carboniferous of the Pictou Coal Field. Returning to the silurian outcrop at Wier's, we proceed south east to Cameron's brook, where I found soft argillaceous strata, like the Clinton of Arisaig, with abundance of characteristic fossils! These overlie the metamorphic of Wier's mountain. I found no appearance of higher strata connected with those. Where the brook enters Sutherland's river, in front of and above the falls, there is a singular meeting of rocks. Above the fall strata in the river itself, there is an exposure of greenstone, which passes into the bank of the river. Between the river and Cameron's brook there is greenstone, which forms a considerable eminence over against the factory, on the side of the brook, and up the brook, until it comes up to the New Glasgow road. South of the falls are Medina sandstone strata, with their peculiar petraia and lingulæ. Passing along the New Glasgow road towards Sutherland's river, on the left of the road, the greenstone which originates above the falls on the right side of the road, and overlying the greenstone, are Medina strata, with lenticular beds of *orthids*, such as are found in similar beds in McDonald's cove, Arisaig; and also beds of *athyrus*, as at Lochaber. Overlying these at the old road, near where it is cut by Cameron's brook, are Clinton strata, from which I got a beautifully ribbed organism, which is in the Museum of the Geological Survey of Canada. Returning to the road I found, opposite the school house, Clinton strata: these overlie the Medina already mentioned, continued on to Sutherland's river and beyond it, which forms the site of McPherson's grist mill. Under the mill I found these Medina strata overlaid unconformably by lower carboniferous grits,—the latter butting against the former. Passing on towards the falls we find, in these sandstones in the bed of the river, a salt spring, the favourite resort of cattle; these may be seen congregating here from all quarters. Invalids may also be seen following their example, in the belief that the spring is, like quack medicine, omnipotent for the cure of all diseases. Overlying the Medina strata, and south of it, are Clinton strata. The former is exposed on either side of the bridge, and the latter above it,—both are fossiliferous. Farther south, up a branch of a small brook that enters Sutherland's river, above the bridge, is a considerable fall, (Fraser's.) The rock of the fall is Medina formation. Passing along the bridge towards Blue Mountain, my attention was turned to lofty banks on the left side of the road. As soon as I saw them I was struck with the resemblance they bore to the strata of my Barney's River lingula nodule bed. I made up my mind to collect similar nodules out of them, and they forthwith turned up in considerable abundance, of the same species as at Barney's

River. I crossed the fields until I came to Sutherland's river. I found a fine section of the shales on the river, with the nodules rolling out of them. In the shales were abundance of concretions, similar to those of the black grapolite and lingula shales of Doctor's brook, Arisaig. This is the only locality that I have found having shales identical with the lower Clinton of Arisaig. This resemblance of the river shales to those of Doctor's brook, and the striking resemblance of the banks on the side of the road to the lingula beds of Barney's River, enabled me at once to settle beyond dispute the horizon of the Barney's River lingula bed, which I had before done with some misgivings. The section of black lingula shales is a little below the place where a small brook that crosses the road enters the river. South of this exposure of shales, on the west side of the river, rises a hill, where there is an outcrop of greenstone porphyry. Still farther south, or about two miles in a straight line from the bridge at the mill, is a mountain of considerable elevation, called McDonald's mountain. The northern side of the mountain is porphyry, and the south is metamorphic slate,—the two terminate on the east side in a noble bluff, which is easily distinguishable from the bridge. I have not surveyed on the west side of Sutherland's river beyond this mountain. Entering Sutherland's river to the east of the mountain, and descending it a little way, I found lower Helderberg strata, with characteristic fossils. The river course is almost in the line of the strike. These rise in the bed of the river in magnificent forms, making rapids and waterfalls which made me somewhat tremulous when attempting to examine them. This is, without exception, the most imposing display that I have witnessed of lower Helderberg strata. I would advise every Geological student to make a pilgrimage to this Geological shrine. They can be seen to advantage by making a descent into the river directly opposite the first porphyry elevation, south of the lingula shale section. The strata under examination pass out of the river below the falls, crossing the little stream referred to when describing the lingula shale section, making in this strata a deep fall, a little below the Blue Mountain road. When I examined it there had been a clearing just made, and a mill was in process of erection. These strata then cross the road and pass northward on the sides of the mountain, where I collected characteristic fossils. They continue their course until they terminate near a small lake which supplies a small stream which descends into Sutherland's river, below McPherson's mill. In this stream there is a section of rocks which deserves attention. Above the road it passes over a greenstone rock, and then crosses the bank on the right with an exposure of lingula shale, whose relation to the other rocks I was puzzled to understand. It is at all events the last of the silurians on the north of the Sutherland river silurian field. Farther up the greenstones rise in a gorge, making a nice little waterfall. This greenstone reaches to within a little of the lake, and then passes over in a northeasterly direction. On the north east side of this little lake is an outcrop of silurian strata, which is probably of Clinton age. Farther east we come to McBeath's, and find outcrops of lower Helderberg strata, with a low northerly dip. Every heap of stones around furnish lower Helderberg fossils. Passing on to the mountain that stands highest in the range, east of Sutherland's river, I found the ridge of strata on the summit to be lower Helderberg. South east of this are lower elevations, having lower strata, metamorphic, which terminate rather abruptly, with a steep descent; at the bottom of this runs a small brook, which appears to be the continuation of the small stream which enters Sutherland's river, near its falls, as I have already noticed. As I have got back to this point, I would turn attention to a singular arrangement of the silurian formations in this direction. The Helderberg strata of the river and of the fall of this small stream, are seen to be underlaid by dark shales with lingulæ. These are exposed on the side of the road, and in the bed of the stream: they are Clinton shales. Passing along the road toward the Blue Mountain, I found beyond Holmes's store an outcrop of strata, on the left side of the road. Here I collected, *in situ*, characteristic lower Helderberg fossils. Now this happens to be a continuation of the lower Helderberg strata of the lofty mountain last referred to. So that we have two sets of lower Helderberg strata, viz: the river strata and the mountain strata, both dipping in a westerly direction, but diverging northerly, having an older formation lying between them. The converging direction being southerly, they would appear to have their centre east of McDonald's mountain, near the place where I met with the strata at first on entering the river.

The lower Helderberg outcrops that I have described in this quarter, appear to lie on the sides of a triangle, whose apex is opposite McDonald's mountain, which has the course of the river for one side, the continuation of the outcrop on the road, and the mountain strata for the other side, and the strata at McBeath's for the base, and Clinton strata situate in part of the area. This seems to show that there had once been a mesial fold in this area, that the crowning Helderberg had been removed by denudation, and that the underlying Clinton strata had been exposed as we now find them. I examined for a considerable distance to the south of the supposed apex, and found silurian strata outcropping all along, until I reached the site of McIntosh's saw mill. In this direction all the strata are metamorphic. The outcrop at the mill, forming a fine fall, appears to be of Medina strata. Descending the river, I reached metamorphic Clinton strata in the river and on the east bank of it, having abundance of veins of quartz,—one of the reputed gold fields that I have already referred to. This is evidently a continuation of the metamorphic strata which I have just noticed as underlying the lower Helderberg strata of the mountain.

I have yet to connect the lower Helderberg strata at McBeath's with the Clinton of French River, where it crosses the road between New Glasgow and Antigonishe, and to lay down the order of formation at the mouth of Marshy Hope, and draw the silurian boundary line from Mill Brook to the Marshy Hope, in order to complete the line between McNeil's brook, Arisaig, and McDonald's brook, East Branch, East River, and survey several important areas included within these boundaries, before I can map out satisfactorily the silurian systems of Antigonishe and Pictou.

It may seem strange that during my description of the area underlying the Pictou Coal Field, I have made no mention of the Devonian formation which is *so often spoken of* in connection with the strata underlying this coal field. The reason why is this: *there is no Devonian to be found there.*

Art. VIII.—Monograph of Ericaceæ of the Dominion of Canada and adjacent parts of British America.

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(*Read April* 10, 1871.)

The order Ericaceæ embraces plants which for beauty are not excelled by any that are known to Science, and although their affinities are clear and the order is a perfectly natural and well defined one, yet its members are so polymorphous that there is not only great variety within its limits in habit and foliage, but also in the structure and number of parts of the flower, and in the real character as well as outward aspect of the fruit. Most of these plants are shrubs, some tall and erect, others dwarf and procumbent; some have deciduous leaves, others are broad-leaved evergreens, the duration of the leaves often differing in species of the same genus; some are humble herbaceous plants with a rosette of evergreen radical leaves and annual flower-stalks; and some are scaly leafless parasites. In the Whortleberry group the calyx-tube is adherent to the ovary, forming a succulent fruit. In the Rhododendron and Heath Group, there is no adhesion, and the fruit is dry and dehiscent, except in Arctostaphyllos, which has a succulent fruit. In the Pyrola group the corolla is polypetalous; in most of the other groups it is gamopetalous and usually but not always regular, the petaloid divisions of equal size. In this order we have the connecting link that bridges over the gap between polypetalous and gamopetalous exogens, for it includes some plants that must be referred to the one division, and some that as surely belong to the other, thus showing that the distinction is neither an absolute nor a natural one when applied to orders.

The largest and most showy plants of the order belong to the Rhododendron tribe, of which many new species have been discovered and introduced to gardens of late years. M. Maximowicz has re-arranged the genera of this tribe in accordance with the growing opinions of botanists that some of the old generic distinctions must be laid aside. His two primary groups are: 1st. Phyllodoceæ, with a firm closely adhering seed coat destitute of wing-like appendages, flowers in the axils of the older uppermost leaves. Phyllodoce, Loiseleuria, Kalmia. 2nd. Eu-Rohododendreæ, with loose seed coats prolonged into wing-like appendages, flower buds surrounded by scaly overlapping bracts, and usually quite distinct from the leaf buds. Ledum, Menziesia, Rhododendron. In the last mentioned genus, Azalea and Rhodora are both merged, as the characters depending upon regular or irregular corolla, sėparate or combined petals, number of stamens, annual or biennial leaves, membranous or coriaceous, and presence or absence of scales, are not available for generie distinction.

The general features of distribution of these plants over the globe were pointed out. They are social plants wherever they are found; they cover immense tracts at the Cape of Good Hope, the species of that region being the beautiful forms known in our conservatories as Cape Heaths. They are in other forms of the same or closely allied genera, the characteristic plants of the "moors" and "heaths" of Northern Europe, "with their purple blossoms rich in honey." They are in like manner the peculiar vegetation of our Nova Scotian "barrens," producing rich flowers in early summer time, and later in the season, furnishing a bountiful sustenance to the furred and feathered game of the country, and offering to the rural population more fruit than they can either use or sell. In Northern Asia they clothe the Himalayan slopes with evergreen foliage and the gayest of flowers, and fill the atmosphere with their too powerful odours. On the lofty mountains of South America they creep as far up towards the summits as it is possible for plants of any kind to exist. And in North America they stretch from the arctic shores southward along the several ranges of mountains, or step from peak to peak, over the whole continent. It is in cold countries alone, and especially on the American continent that this order rises high in the rank of economic plants.

The paper embraced a detailed description of all the species inhabiting the Dominion, with full information respecting their distribution over the region. By means of extensive series of specimens collected by members of the Botanical Society of Canada throughout the Provinces of Ontario, Quebec, Nova Scotia, New Brunswick, Newfoundland, Labrador, Manitoba, and the Northern and Western regions so long occupied by the Hudson's Bay traders, the distribution of the various species has been ascertained with some degree of precision from the southern boundary of the Dominion northwards to the arctic shores, and westward to the Rocky Mountains, but in regard to the Pacific side there was still great want of information. The Ericaceous Flora of the Pacific Coast shows in some respects a closer affinity than that of the Atlantic to Asiatic and European forms; but on the other hand a large number of our Dominion species belong to the old arctic flora that encircles the northern polar regions.

Gaylussacia resinosa is our common Black Huckleberry, widely diffused over the Dominion, but nowhere so abundant or so well known as in Nova Scotia. Vaccinium macrocarpum is the American Cranberry, of which several varieties are now in cultivation; it abounds in the swamps of Nova Scotia, Newfoundland, Sable Island, around the Gulf Shores, and generally throughout New Brunswick, Quebec and Ontario, stretching westward through British territory to the Pacific, where its use is known, although quite absent from the prairie country of the Western States. V. Pennsylvanicum and corymbosum yield the well known blue berries. Vitis Idæa, a common form in Northern Europe, is frequent on hills on both sides of the Lower St. Lawrence, and around the Gulf Shores, Anticosti, Newfoundland, Nova Scotia, New Brunswick, &c., extending north to 70° and west to Sitka. In Europe the use of its berry is not known; in New England Prof. Gray speaks of it as barely edible, and Mr. Wood also, in his American Flora characterizes it as mealy and sour. All that is true of it in the raw state, but it is nevertheless one of our very best berries for cooking, making a delicious preserve, and used all over the Province under the name of Cowberry. It is extensively used also throughout Rupert's Land, where it is *the* Cranberry, and according to Richardson "excellent for every purpose to which a cranberry can be applied," being a great resource to the Dog ribs and Hare Indians, as well as to Europeans. In Greenland, the Danish residents also use it as a preserve, according to R. Brown secundus, in

Florula Discoana. V. Oxycoccus extends across the continent, but is not very common. V. Myrtillus is confined to the Pacific region. Chiogenes hispidula the Capillaire or Maiden Hair of Nova Scotia, produces its white wax like berries so abundantly that they are made into an elegant preserve, especially in Cape Breton. Arctostaphyllos alpina is a Newfoundland and common northern species, not well known in Southern Canada, but stretching along the whole arctic coast. In the specimens sent by Mr. McTavish the fruit is black, but Sir John Richardson describes a red-fruited sort also. A. Uva-urisi is common throughout the Dominion, apparently increasing to the north and west, whence Dr. Schultz, M. P. P. for Lisgar, sends it as the Kinikinik of the Crees, who, as well as European fur traders, mix its dried leaves with their tobacco. Epigæa repens is the emblematical "Mayflower" of Nova Scotia; "we bloom amid the snows." It extends through the United States, but only along the Atlantic seaboard, and is not uncommon along the shores of the St. Lawrence Gulf, and although extremely rare in Ontario, extends to the Saskatchewan. Its flowers exhibit dimorphism, in reference to which several points were suggested for investigation, and Mr. Jones, F. L. S., expressed the belief that fertilization was effected by the large humble bee of Nova Scotia. Gaultheria procumbens is a common Canadian plant, yielding the fragrant oil of winter green, which has of late years been much used by perfumers. This oil consists of an acid ether, methyl salicylic acid, which, when distilled with caustic potash, yields methyl alcohol and salicylic acid.

In Gaultheria procumbens a remarkable structure was described; there projects from each tooth of the leaf a long terete brown glandular process, arising from a larger base. A similar structure is seen in the G. Shallon of the Pacific Coast, but there is in addition scattered over the lower surface of the leaves of that species brown dots, which are the rudimentary bases of similar but undeveloped processes. In the East Indian G. ovalifolia of Wallich (1523), Hooker's Icones, 246, these gaultherian processes, as they may be called, are fully developed, not only on the margins, but over the whole lower surface of the large leaves, each gland arising from a large flattened disk-like base. These peculiarities do not seem to have been previously described; they will probably be viewed as presenting a case of development, the peculiar structures commencing in our Nova Scotian G. procumbens, where they are confined to the margins of the leaves, developing, as an intermediate stage, in G. Shallon, where their rudiments appear on the lower surface of the leaf likewise, and finally acquiring completeness in G. ovalifolia, in which the whole under surface and margins are provided with them in the most highly developed form.

G. Shallon does not come eastward more than a hundred miles from the Pacific Coast. Cassandra calyculata abounds in every swamp about Halifax, and is not rare throughout the Dominion; in the far north it becomes more scaly. Andromeda polifolia grows in Newfoundland, Labrador, Anticosti, but is chiefly a northern species, extending to the arctic shores, and often bearing the black blotches of Rhytisma Andromedæ, observable on the cultivated plant in European gardens. A. tetragona is an extremely arctic species, forming a turf, which affords a scanty fuel to voyagers in the most desolate regions; it grows on all the arctic shores of the old and new world. A hypnoides, which occurs on the White Mountains and Labrador, is one of our rarest plants. Kalmia glauca is chiefly confined to the maritime Provinces, and probably does not produce its flowers in Ontario. It was known to European Botanists long before being described in Hortus Kewensis; it is the K. linearifolia, Menzies, who found it last century "in paludibus juxta Halifax, Nova Scotia;" and specimens collected by Sarrazin nearly two hundred years ago were found by Smith in 1786, in the then old Herbarium of Valliant at Paris. K. angustifolia is one of the handsomest plants of our Nova Scotian barrens, and seems to thrive best in the poorest soils, where it has plenty of moisture, exhibiting with us a very different appearance from that which it presents in inland localities. K. latifolia has been recorded by Sir John Richardson, Mr. Billings and others, as Canadian, but there is no evidence of its existence within our limits. Rhododendron Canadense is an Atlantic plant, especially abundant in Nova Scotia, where Colonel Hardy has found a variety with pure white flowers. R. Lapponicum is chiefly of northern range. R. maximum is not known within our limits, although Gray says it is an inhabitant of Maine. Ledum latifolium is not uncommon in swampy grounds, especially in the maritime provinces, where it blossoms profusely, and farther north the narrow leaved L palustre, with twice as many stamens, seems to take its place. Loiseleuria procumbens, a dwarf alpine plant of northern Europe is extremely arctic with us, but finds a resting place on the lofty summits of New Hampshire; it is one of the fuel plants of the arctic voyagers. Moneses uniflora is found at Mount Uniacke, by the Rev. J. B. Uniacke, Rector of St. George's, and other Pyrolæ are not rare. Pterospora is confined to Ontario. For the Scotch Heather, Calluna valgaris, several localities have been ascertained in Nova Scotia and Cape Breton, in addition to those previously published.

In conclusion the Author referred to the poisonous and intoxicating properties attributed to some Ericaceæ. Kalmia angustifolia is well known to our farmers as "Lamb poison," from the sickness and occasional deaths caused to lambs that nibble the young shoots in early summertime. Burnett has attributed poisonous effects to the honey of Kalmia latifolia in the United States. The following notices of poisonous honey have been kindly furnished by Professor Johnson, of Dalhousie College:—

From Xenophon's Anabasis:—"Having passed the summit, the Greeks encamped in a number of villages containing abundance of provisions. As to other things here, there was nothing at which they were surprised: but the number of bee hives was extraordinary, and all the sailors that ate of the combs lost their senses, vomited, and were affected with purging, and none of them were able to stand upright; such as had eaten a little were like men greatly intoxicated, and such as had eaten much were like mad men, and some like persons at the point of death. They lay upon the ground in great numbers, as if there had been a defeat; and there was a general dejection. The next day no one of them was found dead, and they recovered their senses about the same hour that they had lost them on the preceding day; and on the third and fourth days they got up as if after having taken physic."

Pliny's Natural History, Book XXI. Section 44.—"At Heraclia in Pontus the honey made by bees in some years is most dangerous. Writers have not mentioned from what flowers this is collected: We shall record what we have discovered. There is a plant called aegolethron [goat's bane, literally; probably the *Azalea*

Pontica, Linn.,] from its killing beasts and especially goats; from the flowers of this plant bees gather a dangerous poison, when it decays in a wet spring. The signs of poisonous honey are: it does not thicken at all, its colour is rather red, its strange smell immediately produces sneezing and it is heavier than harmless honey. Those who have eaten it throw themselves on the ground, trying to cool themselves, for they burst into a profuse perspiration. There are many cures which we will mention in their proper places. But as the danger is great, it may be as well to indicate some at once; such as old mead made of the best honey and of rue, and salt fish taken frequently if it be thrown up. It is certain also that this poison reaches dogs through the excrement, and that they are put in like pain. However it is well known that mead made of it when kept till old is quite harmless, and that women's complexions are not improved by anything better than by this when combined with *costus* (an oriental aromatic plant) and with bruised aloe."

Pliny's Natural History, *XXI.*, 45.—"In the same region of Pontus in the tribe of the Sanni there is another kind of honey which is called mæonomenon (maddening) from the madness it produces. It is supposed to be collected from the flower of the rhododendron, with which the woods abound, and when this tribe give the Romans wax as tribute, they do not sell the honey because it is fatal."

Strabo's Geography, *Book XII.*, *Sec.* 18, (Ed. Teub.) "The Heptacometæ (a people of Pontus) destroyed three cohorts of Pompey which were marching through the mountains by putting on the roads cups of maddening (mænomenon) honey, which the twigs of trees produce, for they easily slew the soldiers who were driven mad by the draught."

Art. IX.—On the Meteorology of Halifax. By Frederick Allison, Esq.

(Read May 8, 1871.)

January, 1870, was a month of unusual warmth, more than 7° above the average temperature of eight years, and not approached by any January since 1863. The pressure was great on the whole. Some of its more remarkable peculiarities are noticed in a paper read by me before this Institute in May last. Cloud was rather scanty, and winds strong from the usual north west quarter. The total precipitation was very large; the rain fall more than supplying the deficiency of snow. We had no fog, five auroras, five hoar frosts, three lunar halos, four gales, and but five days sleighing. The strong east gales at the close of this month have also been fully mentioned last year.

February came nearer the normal temperature. Its whole pressure was very light. I must again refer to last year's paper for notable barometrical disturbances in this month. Cloud far exceeded that of January, and its own average; prevalent north west wind strong; great precipitation, being nearly double the average amount, especially large in rain. There was but one fog, two auroras, and three hoar frosts, two lunar and one solar halo; three gales were felt: that of 9th morning was strong from east, and blew again at night from west. There was sleighing nearly all February, from beginning to 25th.

The following month, March, was very similar in general temperature, but the minimum of the year occurred on the 12th of March. Pressure of the atmosphere still extremely small, with a range rather limited for the season, and not much force of vapour. For this month also some barometrical notes are contained in Proceedings of this Institute for 1870. The brightness of the approaching spring was well defined in March, when cloud was in decided defect. Prevalent wind direction, N. N. W., and mean force great. A decrease in rain and snow fall, but chiefly in former, left total of the two not much above two thirds of average. Wild geese passed on 19th, peach blossomed 24th, and wild pansies 28th. Again one fog, and the large number of eight auroras; five hoar frosts were noted, two lunar halos, three gales were felt—counting those of 17th and 18th as two,—all more or less eastwardly; we had eleven days of sleighing; robins reappeared 30th.

April temperature returned to a figure much above the normal. The minimum was high, 22°.6, and the maximum 66°.4. The pressure mean 29.743, was but .001 below an eight years average; and the monthly percentage of relative humidity, 86.1, the greatest in 1870, cloud still remains deficient. The prevalent wind was E. S. E., a peculiar direction, and small force. Total precipitation was a very little below the average; for while rain was in excess, we had less than one inch of snow, and only on two days. Fogs rose to the number of five, auroras five, hoar frosts six, thunder and lightning once—on 12th—first of season. A short gale blew on morning of 20th, from E. S. E.; frogs sang on 8th, and mayflowers were in full bloom 12th.

The mean temperature of May was a little lower than average. On the 30th the great heat of 80°.2 was attained. The mean pressure was not far from normal, but rather weak, and the Hygrometrical means were decidedly small for the season. The month was also very free from cloud, and wind force less than usual. With these conditions it is not surprising to find the rain fall deficient. An eight years average gives 4.33 inches; this May only 3.19; snow fall was inappreciable; and fair days twenty one, or six above average. Of fogs we had four, auroras six, hoar frosts two, thunder and lightning on 9th and 12th; humming birds were seen 18th, cherry blossomed 23rd, and the whole spring was rather advanced; the latest snow fell on 24th, melting as it fell.

June, compared with this month in past years, was not unlike May, compared with its predecessors: being slightly cool, somewhat low in pressure, and decidedly bright. The month was still more dry than the foregoing, only 1.69 inches of raln failing. The force of wind had previously been estimated. Now, having received and placed in position an Anemometer, (Robinson's improved,) I was enabled to measure the velocity, which in June gave a mean of only 8.8 miles per hour, with a resultant direction (calculated from direction and velocity) of south 70° west; three fogs were present, two auroras, no frost—the latest this season, both at five feet above ground and on surface—coming on 24th May. Thrice was thunder heard, and lightning visible on two occasions, from beginning of 20th to end of 21st, both being frequently heard and seen; one solar halo, one lunar corona; white lilac bloomed 7th, the purple 8th, the apple on 6th, and white hawthorn 7th, red clover blossomed 6th, the horse chestnut 2nd, the honeysuckle 11th, strawberries were ripe 20th, peas blossomed 17th, grass mowing began 30th; the whole season was now decidedly early.

July was a warm month, 1°.85 above the average; on the 24th the thermometer reached 91°.5 and the 25th was excessively hot; mean of six observations on that day 75°.27, being the warmest of any day recorded in Halifax in at least twelve years. Mean pressure continued low, and largely composed of force of vapour; the want of cloud was very marked, and winds light—mean velocity being only 8.1 per hour—resultant direction south 69° west. Rain is not usually abundant here in July, but this had more than any of the summer months of 1870—3.21 inches, or an excess over the average of 1.02. I record four fogs, six auroras, thunder once, and lightning twice, two lunar coronas, and two rainbows; blossoms and fruits were still early.

As the summer progressed the relative heat was maintained, and August in some respects closely resembled July, the pressure, 29.659, being almost identical, and amount of cloud one tenth less; the atmosphere was sensibly more dry however; the wind had veered farther northward, resultant direction north 77° west, and mean velocity increased to 10.5 miles per hour; but 2.20 inches of rain fell, scarcely two thirds of calculated average; number of fogs was three, auroras five, thunders three, and lightnings three, one lunar halo and one lunar corona. The advance of the season, in animal and vegetable life, proceeded at about same rate as before remarked.

The temperature of the year made a greater decline than usual in September, which month had a mean temperature of 57°.20, or 7°.68 below August. The atmosphere never descended to the freezing point, but on 30th 32° were registered by grass minimum thermometer. The average date of first appearance of this phenomenon is 19th September. Mean pressure did not yet reach its normal. Hygrometric results were about as usual, with still a great deficiency of cloud, and wind not strong generally, resultant direc tion was north 15° west, and mean velocity 10.6 miles per hour; rain was .50 short; three fogs were observed, three auroras, one hoar frost, as noted above, one thunder and lightning, two lunar halos, and one solar corona, one rainbow, three gales. In the gale of 4th wind reached 70 miles per hour, from six to seven a. m. The progression of temperature brought the usual signs of declining summer, at a date quite as early as customary.

October was decidedly a warm month, with a mean temperature 48°.14. The mean pressure was 29.825.005 higher than January,—and the highest monthly mean in 1870. Elastic force of vapour .294, and relative humidity 82.8. There was still a want of cloud, though October is frequently a bright month in Nova Scotia. In wind there was an evident increase of average force, the mean velocity being 12.45 miles per hour, with a resultant direction north 42° west. The rain fall was heavy, and more than twenty five per cent above the average, though coming on few days; .8 of inch of snow fell; we had no fog except for half an hour early on 31st; three auroras were marked, hoar frost on 7th and 24, three lunar halos, hail on 26th, and a rainbow same day; there were three gales from N. W., S. S. W., and S.; first frost 26th, the atmosphere having been above 32° one hundred and fifty five days, since May 24th; first snow 29th, first measurable snow 31st.

Mean temperature of November still remained above the average, while the whole pressure of the atmosphere was small, and fell much from that of October. This pressure was composed largely of force of vapour. November, generally a cloudy month, was rather less so than usual this year. The resultant direction of wind was nearly due west, being north 87° west, and the mean velocity in miles per hour receded nearly to that of September—10.75 per hour. Rain fell to a depth of 5.67 inches, which is just one inch above the average; and 7.7 inches of snow fell, which is almost double the usual amount. There were three fogs, five auroras, two hoar frosts, three lunar halos, and a corona; three gales were felt from N. W., S. S. E., and S. E.; meteors night of 14th.

The winter began very mildly; December having a mean of exactly 30° or 3°.61 over the average temperature. In this mild month pressure was naturally very low, force of vapour and relative humidity comparatively high. The mean clouding was large, and considerably more than any other month in the year. Winds were not strong on the whole, the mean velocity being 11.6 miles per hour, resultant direction north 76° west. Rain was much above the average, and snow below, though the latter contained more water than is usual; so that the total precipitation was large. But one fog was present, three auroras, seven times hoar frost, four lunar halos, and two coronæ; we had four days of sleighing. The thermometer did not fall nearer 0 than 4°.6 on Christmas Eve.

Annual results are thus briefly summed up: 1870, mean temperature 44°.67. Above average 1°.33. Maximum heat, 91°.5; minimum,—7°.3; annual range, 98°.8; mean maximum, 53°.57; mean minimum, 35°.92; highest daily mean, 75°; lowest daily mean, 7°.17; mean daily range, 17°.61; greatest daily range, 41°.7; mean pressure, (corrected,) 29.684; below average, .074; maximum pressure, 30.484 in October; minimum pressure, 28.455 in January; whole range, 2.029; highest daily mean, 30.347; lowest daily mean, 28.694.

The mean elasticity of aqueous vapour was .278, and mean humidity 78.3.

Mean cloud was 5.4, which is 0.6 less than a four years average; N. W. wind prevailed, with an estimated mean force of 1.8, or 0.3 below eight years average.

We had 48.27 inches of rain, 4.81 above the average. This fell on one hundred and sixteen days, against one hundred and eleven days in 1869, and one hundred and twenty three days average of eight years; 78.9 inches of snow fell, which is 6.6 inches more than the average, and 13.4 inches more than 1869; number of days of appreciable snow was thirty six, eleven less than usual, but nine more than in 1869. The total precipitation, of rain and melted snow added, reached 57.19 inches, 5.66 inches more than the average, and 2.66 above the preceding year; of fair days, or those entirely free from measurable rain or snow, there were two hundred and twenty nine; two hundred and four is the average number.

Days wholly or partly foggy were twenty nine,—in 1869 there were thirty six fogs; fifty three auroras were observed,—in 1869, thirty nine; thirty three times was hoar frost formed,—in 1869, 37 times; on ten days we had thunder, and on eleven days lightning, generally together; these numbers in 1869 were eight and seven; I saw twenty six lunar halos, and three solar halos,—in 1869 but twelve of the former and none of the latter; hail fell but once, both in 1870 and in 1869; and four rainbows were noticed in each year. Last year there were forty five days of sleighing, and in

1869 fifty days; the first snow flakes were ten days later than average, and the latest since 1863; first measurable snow, however, was ten days early; the first frost twelve days late, and about four days longer than the average.

Thanking my hearers for bearing with the recital of these figures, I turn for a little while to another phase of meteorology, not more important than statistics,—less so indeed in the sense that a superstructure depends for support upon its foundation,—but more generally interesting. A gale on the 4th September, 1870, is mentioned in the above record, and probably not forgotten in Halifax, as one of the most severe storms ever experienced here. This was a cyclone, as proved by the following facts:

The 3rd September was damp and sultry. Between 9 p. m. and midnight Barometer fell one-tenth; wind S. S. E., fifteen miles per hour. 4th, 3.40 a. m. fine rain driven by a 4lb S. E. wind, Barometer falling faster, and temperature high and almost steady; 4.5 a. m., the ball opened with a vivid flash of lightning, quickly repeated and followed by low grumbling thunder. The wind now rapidly increased, with violent showers, till 6 a. m., from same quarter; rain then measured .19 inch, and fell subsequently in light dashes. At 6 o'clock the Anemometer was revolving at 57.9 miles per hour, force 17.3 lbs per square foot. During the next hour the gale, still S. E., was at its height here, completing 65.7 miles in that time, with some gusts at rate of 70 miles. It was in that period that the chief damage was done here; the carriage factory on the common unroofed, and many trees, fences, &c., blown down. These accidents are not to be wondered at, when it is remembered that the wind was occasionally exerting a pressure of fully 24.5 lbs. on every square foot. With some variations wind was less after this, veering towards south. At 10 a. m. it was due south, and a comparative lull was experienced from 10½ to 11 a. m. Barometer corrected for altitude, and reduced for temperature, reached the minimum, 28.952 at 9½ a. m. At noon the gale was partially renewed from S. W., and though declining, blew strongly till 5 p. m., when direction was from W., rate 34.8 miles per hour, Barometer 29.542, and rose another tenth in succeeding hour. Sky clear at 5½ p. m., when gale had passed.

A fog next morning. All the chief features I have mentioned agree perfectly with the theories of Redfield and Reid, embodied by Dove, and the observations of numerous men of science. Note especially the sudden Barometrical decrease, the shift of wind with the sun, and comparative lull as the hurricane's centre was nearest to Halifax. The lightning flash, succeeding the rain, speaks for the electric consequence of the latter.

Let us pass on to consider this storm at other points in and near Nova Scotia. From Glace Bay, Mr. Poole (whose valuable record I have just had the honour of reading) sends me the following notes: 4th September, 1870, 8 a. m. corrected Barometer 29.740; 3 p. m. 20.333, wind 11 a. m. S. E., 50 miles per hour.

noon	S. E.	68	"	"
1 p. m.	S. S. E.	74	"	"
2 "	S. S. E.	84	"	"
3 "	S.	86	"	"
4 "	S.	72	"	"
5 "	S.S.W.	65	"	"
6 "	S. W.	55	"	"
7 "	W.S.W.	46	"	"

Rain from 9 a. m. till noon = .36 inch.

From farther north an officer on board H. M. S. "Valorous," then in Charlottetown harbour, sent this report:

Barometer 4th Sep., 4 a. m., 29.97; noon, 29.01; midnight, 29.73. Wind, 4 a. m., S. E., squally, 3

8 "	E.	4 to 7
noon,	S. b. E.	5 to 8
4 p. m.	W. b. N.	5 to 8
8 "	N. W.	2 to 3

During the evening the wind there was variable both in force and direction, swinging back even to west. "Force according to Beaufort's scale"—where 8 represents a "fresh gale." At 9 a. m. the "Valorous" "dragged and got up steam;" at 10 a. m. "weighed and shifted berth."

Several observers have kindly forwarded reports of this storm, but our present purpose will be accomplished, and time best suited, by reference to observations from a point S. E. of this. On board the S. S. "Robert Lowe" at sea, Lat. 43°2′ N., Long. 65°3′ W., "the night" (of 3rd—4th Sept. 1870) "was very dark, and the wind from E. via S. to W., must have been at its height quite equal to, if not exceeding the velocity given in the accompanying paper"—say 25 lbs—"The sudden and fitful gusts were of enormous force, more resembling the escape of steam from a high pressure engine than anything else. Our Barometer reached at 4 a. m. 28.700." "Steaming head to wind throughout the storm our drift would not exceed a radius of seven miles." These four sets of observations alone clearly shew a general E. N. E. direction of the storm path. Lowest Barometer, "Robert Lowe," 4 a. m.; Glace Bay, 3 p. m.; or a distance of about 250 miles in 11 hours—23 miles, nearly, per hour was this cyclone travelling; but its speed, it may be noticed, was accelerated as it progressed eastward. This has been noticed in cyclones in the north temperate zone before, (see Dove's Law of Storms,) and I wish now to draw particular attention to this fact. We cannot speak confidently of the rate of velocity sustained across the Atlantic, without any ocean observations; but reasoning from what we do know of this particular storm, and from comparison of other known storms, this cyclone was due (or rather its south eastern edge) in the Bay of Biscay on the evening of the 6th.

Now let us transport ourselves to that locality, and off Cape Finisterre we find a British squadron cruising on that evening. Shortly after 5 p. m. the Admiral Sir Alexander Milne had left the turret ship Captain, and had gone on board his own flag ship. A wind and boisterous sea were rising; at midnight a gale was upon them; and before 1 a. m. of the 7th September the "Captain" had foundered, with more than a hundred gallant souls. Many of them, from the Commander Burgoyne of the Victoria Cross to the noble young Gordon the midshipman, too well known in Halifax for me to dwell on this episode. Much has been said and written of the construction and loss of this ship; but it is with the external cause of that loss—the gale—that this paper has to do. Unlike the pattern of the iron clad its formation could not have been avoided; but its advent could have been anticipated. Let the meteorological system now finding favour have been carried to completion, and let the

OTIA.

. Height above Sea, 132 feet.

N.

	uly.	August.	Sept.	Octr.	Novr.	Decr.	Year 1870.
Mean Temp	5°.26	64°.88	57°.29	48°.14	39°.20	30°.00	44°.67
Difference fr	1°.85	+1°.65	-.45	+1°.58	+73	+3°.61	+1°.33
Maximum T	91°.5	87°.8	80°.1	70°.0	60°.7	47°.8	91°.5
Minimum T	46°.0	46°.3	35°.8	27° 1	21°.4	4°.6	-7°.3
Monthly an	45°.5	41°.5	42°.3	42°.9	39°.3	43°.2	98°.8
Mean Maxi	5°.98	75°.82	67°.86	57°.30	45°.02	34°.69	53°.57
Mean Minim	5°.22	55°.14	47°.43	39°.86	32° 55	23°.30	35°.92
Highest Dail	75°.0	70°.33	67°.97	60°.67	52°.90	42°.90	75°.0
Lowest Daily	5°.03	55°.80	47°.77	32°.80	25°.80	9°.70	7° 17
Mean Daily	0°.75	20°.71	20°.40	17°.14	12°.48	11°.43	17°.61
Greatest Dai	34°.3	30°.7	32°.6	29.°9	21°.1	28°.6	41°.7
Mean Pressu	.660	29.659	29.769	29.825	29.689	29.605	22.684
Difference fr	089	.088	-.063	+.040	-.045	-.118	-.074
Maximum P	.906	29.906	30.199	30.484	30.394	30.356	30.484
Minimum P	.285	29.294	28.705	29.170	28.963	28.938	28.455
Monthly and	.621	.611	1.494	1.314	1.431	1.438	2.029
Highest Dail	.808	29.885	30.123	30.347	30.296	30.281	30.347
Lowest Daily	.462	29.359	29.126	29.445	29.116	29.021	28.694
Mean Elastic	.523	.492	.388	.294	.207	.142	.278
Mean Humid	83.8	79.6	80.6	82.8	83.2	77.7	78.3
Mean Amour	4.1	4.0	4.4	5 4	6.6	7.0	5.4
Difference fr	-1.5	-1.1	-1.5	-.3	-.5	+3	-.6
Prevalent Di	S.W.	W.N.W.	N.N.W.	N.W.	W.N.W.	N.N.W.	N.W.
Mean Force c	1.0	1.1	1.6	1.9	1.7	2.1	1.8
Difference fr	-.8	-.6	-.3	-.3	-.7	-.3	-.3
Amount of R	.21	2.20	3.33	6.75	5.67	4.81	48.27
Difference fr	.02	-1.01	-.50	+1.64	+1.00	+1.10	+4.81
Number of d	8	8	7	12	11	12	116
Difference fr	-2	-3	-3	-1	-2	+3	-7
Amount of S	0	0	0	0.8	7.7	10.7	78.9
Difference fr	0	0	0	+0.1	+3.9	-3.4	+6.6
Number of d	0	0	0	1	2	7	35
Difference fr	0	0	0	-1	-2	-3	-10
Total Precipi	.21	2.20	3.33	6.85	6.28	6.06	57.19
Difference fr	.02	-1.01	-.50	+1.63	+1.18	+1.23	+5.66
Number of D	23	23	23	19	17	16	229
Difference fr	+2	+3	+3	+5	+3	+2	+25
Number of F	4	3	3	1	3	1	29
" A	6	5	3	3	5	3	53
" H	0	0	1	2	2	7	33
" T	1	3	1	0	0	0	10
" L	2	3	1	0	0	0	11
" L	2	2	2	3	3	6	26
" S	0	0	1	0	0	0	3
" H	0	0	0	1	0	0	1
" R	2	0	1	1	0	0	4
" G	0	0	3	3	3	0	20
" D	0	0	0	0	0	4	45

General Meteorological Register for 1870.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea, 132 feet.

OBSERVED BY F. ALLISON.

1870.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Octr.	Novr.	Decr.	Year 1870.
Mean Temperature	29°.88	24°.58	28°.76	41°.18	47°.12	59°.88	65°.26	64°.88	57°.20	48°.14	39°.20	30°.90	41°.67
Difference from average (eight years)	+7°.01	+.75	+.59	+2°.87	-.49	-.13	+1°.85	+1°.65	-.45	+1°.58	+73	+3°.61	+1°.33
Maximum Temperature	50°.05	47°.3	52°.4	66°.4	80°.2	86°.7	91°.5	87°.8	80°.1	70°.0	60°.7	47°.8	91°.5
Minimum Temperature	-3°.3	-3°.1	-7°.3	22°.6	27°.4	38°.4	46°.0	46°.3	35°.8	27°.1	21°.4	4°.6	-7°.3
Monthly and Annual Ranges	53°.7	50°.4	59°.7	43°.8	52°.8	48°.3	45°.5	41°.5	42°.3	42°.9	39°.3	43°.2	98°.8
Mean Maximum Temperature	37°.86	32°.19	36°.81	50°.48	58°.03	70°.82	75°.98	75°.82	67°.86	57°.30	45°.02	34°.60	53°.57
Mean Minimum Temperature	20°.56	16°.24	21°.5	32°.68	37°.42	49°.07	55°.22	55°.14	47°.43	39°.86	32°.55	23°.30	35°.92
Highest Daily Mean Temperature	45°.87	39°.53	41°.90	50°.97	64°.80	72°.50	75°.0	70°.33	67°.97	60°.67	52°.90	42°.90	75°.0
Lowest Daily Mean Temperature	7°.17	9°.50	9°.83	31°.93	35°.93	47°.90	55°.03	55°.80	47°.77	32°.80	25°.80	9°.70	7°.17
Mean Daily Range of Temperature	16°.98	15°.90	14°.94	17°.97	20°.61	21°.75	20°.75	20°.71	20°.40	17°.14	12°.48	11°.43	17°.61
Greatest Daily Range of Temperature	41°.7	27°.9	35°.1	31°.8	33°.5	37°.8	34°.3	30°.7	32°.6	29°.9	21°.1	28°.6	41°.7
Mean Pressure, corrected	29.820	29.543	29.538	29.743	29.657	29.699	29.660	29.659	29.769	29.825	29.680	29.605	22.684
Difference from average (eight years)	+.106	-.233	-.186	-.001	-.032	-.052	-.089	.088	-.063	+.040	-.045	-.118	-.074
Maximum Pressure	30.467	30.289	30.295	30.311	30.170	29.945	29.906	29.906	30.199	30.484	30.394	30.356	30.484
Minimum Pressure	28.455	28.487	28.928	29.125	29.2[illegible]1	29.218	29.285	29.294	28.705	29.170	28.963	28.938	28.455
Monthly and Annual Ranges	2.012	1.802	1.367	1.186	.969	.727	.621	.611	1.494	1.314	1.431	1.438	2.029
Highest Daily Mean Pressure	33.324	30.200	30.252	30.282	30.071	29.929	29.898	29.885	30.123	30.347	30.296	30.281	30.347
Lowest Daily Mean Pressure	28.940	28.694	28.965	29.343	29.264	29.343	29.462	29.359	29.126	29.415	29.116	29.021	28.694
Mean Elasticity of Aqueous Vapour	.129	.104	.129	.229	.262	.432	.523	.492	.388	.294	.207	.142	.278
Mean Humidity	66.5	65.9	72.4	86.1	78.5	83.1	83.8	79.6	80.6	82.8	83.2	77.7	78.3
Mean Amount of Cloud	5.8	6.6	5.2	5.9	5.0	5.0	4.1	4.0	4.4	5.4	6.6	7.0	5.4
Difference from average (four years)	-.5	+.2	-.5	-.2	-1.9	-.7	-1.5	-1.1	-1.5	-.3	-.5	+3	-.6
Prevalent Direction of Wind	N.W.	N.W.	N.N.W.	E.S.E.	S.S.E.	W.S.W.	W.S.W.	W.N.W.	N.N.W.	N.W.	W.N.W.	N.N.W.	N.W.
Mean Force of Wind	2.5	2.4	2.8	1.7	1.5	1.0	1.0	1.1	1.6	1.9	1.7	2.1	1.8
Difference from Average (eight years)	+.2	+.1	+.4	-.7	-.3	-.8	-.8	-.6	-.3	-.3	-.7	-.3	-.3
Amount of Rain	5.18	6.82	1.64	3.78	3.19	1.69	3.21	2.20	3.33	6.75	5.67	4.81	48.27
Difference from Average (eight years)	+1.23	+3.40	-1.36	+.67	-1.14	-1.21	+1.02	-1.01	-.50	+1.64	+1.00	+1.10	+4.81
Number of days of Rain	14	7	5	13	10	9	8	8	7	12	11	12	116
Difference from Average (eight years)	+8	+1	-1	+2	-6	-3	-2	-3	-3	-1	-2	+3	-7
Amount of Snow	14.9	29.6	14.4	0.8	Inap.	0	0	0	0	0.8	7.7	10.7	78.9
Difference from Average (eight years)	-2.21	+16.81	-2.4	-7.1	-.1	0	0	0	0	+0.1	+3.9	-3.4	+6.6
Number of days of Snow	9	11	4	2	0	0	0	0	0	1	2	7	35
Difference from Average (eight years)	-1	+3	-4	-3	-1	0	0	0	0	-1	-2	-3	-10
Total Precipitation	7.11	10.34	3.02	3.91	3.19	1.69	3.21	2.20	3.33	6.85	6.28	6.06	57.19
Difference from Average (eight years)	+1.22	+4.54	-1.19	- 10	-1.15	-1.21	+1.02	-1.01	-.50	+1.63	+1.18	+1.23	+5.66
Number of Dry Days	13	14	22	17	21	21	23	23	23	19	17	16	229
Difference from Average (eight years)	-4	-2	+4	0	+6	+3	+2	+3	+3	+5	+3	+2	+25
Number of Fogs	0	1	1	5	4	3	4	3	3	1	3	1	29
" Auroras	5	2	8	5	6	2	6	5	3	3	5	3	53
" Hoar Frosts	5	3	5	6	2	0	0	0	1	2	2	7	33
" Thunders	0	0	0	1	1	3	1	3	1	0	0	0	10
" Lightnings	0	0	0	1	2	2	2	3	1	0	0	0	11
" Lunar Halos	3	2	2	0	0	1	2	2	2	3	3	6	26
" Solar Halos	0	1	0	0	0	1	0	0	1	0	0	0	3
" Hails	0	0	0	0	0	0	0	0	0	1	0	0	1
" Rainbows	0	0	0	0	0	0	2	0	1	1	0	0	4
" Gales	4	3	3	1	0	0	0	0	3	3	3	0	20
" Days Sleighing	5	25	11	0	0	0	0	0	0	0	0	4	45

Transatlantic telegraph have flashed from this coast or from Newfoundland to Ireland the presence of the storm on this side, and its probable oceanic path,—Valentia might have warned Brest and lower stations, and the officer in command of a trial squadron, "looking for a gale of wind," would scarcely have failed to communicate daily with the French or Spanish coast for signals, and to take additional precautions if aware of the approach of a cyclone.

I must not conclude without alluding to the probability of the General Government giving encouragement to the system of meteorological observations which the Director of Toronto Observatory, Mr. Kingston, and myself, have been for some time urging upon them and the Canadian public.

ART. X.—ON THE METEOROLOGY OF CALEDONIA MINES, LITTLE GLACE BAY, CAPE BRETON. BY H. POOLE, ESQ., M. E., *Superintendent of Mines.*

(*Read May* 8, 1871.)

THE accompanying record of the weather, observed in 1870, is in continuation of the meteorological registers forwarded for the previous years back to 1867 inclusive.

The Barometrical readings are a little lower than in former years. The highest reading being 30.560 on 1st January, and the lowest 28.460 on the 1st February, being an extreme range of two inches.

The mean temperature was 41.75, or 1.70 degree warmer than the mean of the previous three years. The mean at night being 1.78 warmer, and at day 1.50 warmer than the mean of previous years. The coldest night was only 2.5 below zero on 13th March, and the hottest day was 89.5 on 24th July. Only three nights marked below zero, though previous years had marked six, fifteen and seven. The nights of frost were one hundred and eighty three, being the average of former years, but the degrees of frost were only 1499 against 1794, 2486, and 2171 degrees of former years.

The rimy frosts were forty seven against a mean of twenty six, with eight times of silver thaw, against a mean of five times. Hail was observed eleven times, and fogs sixty one, as compared with a mean of hail six times and thirty one fogs. Lightning and thunder were also more frequent, being seventeen times against a mean of nine times. Twelve rainbows were observed as compared with six in former years, and the unusual number of one hundred and two auroras, instead of a mean of thirty three. Also thirty four halos round the sun and twelve round the moon, instead of an average of twenty two round the sun and five round the moon, as previously. The mean force of vapour was 0.2691 inch, and the relative humidity was seventy four per cent, one hundred being saturation.

The wind continued to give a high mean of 17.4 miles per hour, or a total number of 152,353 miles for the whole year. The wind veered thirty eight with and backed seven times against the sun, making full revolutions; while the prevailing directions were one hundred and twenty three days from S. to W, ninety nine days from W. to N., eighty five days from N. to E., and fifty eight days from E. to S. In March the wind averaged 24.5 miles per hour throughout the month. The equinoctial gale blew on the 17th, 18th, 19th and 20th; the greatest force being on the 18th from 1 p. m. to 8 a. m. of the 19th, an average of 70.5 miles per hour; thence to 1 p. m. of the 19th, 89 miles per hour; and from 1 p. m. to 4 p. m. 88 miles per hour; and from the whole 24 hours of the 19th, an average of 72 miles per hour. The direction of the wind was north, and nine inches of snow fell. A total of one hundred and two inches of snow fell on fifty six days, which melted and added to the rain gave a total precipitation of 62.625 inches of water on one hundred and sixty days.

Table No. 2 exhibits the rainfall compared for four years. It shows that the least quantity falls in August, then July, June, May, April, March, January, February, October, November, December, and the most in September. In 1870, May had the least rain fall, 1.705 inch, shewing a reasonable excuse for the shortness of the hay crop in that year. The greatest fall of rain in one month was 11.265 inches in September 1867.

West. 120 feet above Sea.

111.5	63	189	2470	19					19								112	126	66	61

METEOROLOGICAL REGISTER, CALEDONIA MINE, LITTLE GLACE BAY, CAPE BRETON. 60 ft. ABOVE SEA. Lat. 46° 12′ N. Long. 59° 57′ W.

1870.	Barometer. Corrected to 32°.	Barometer. Correc. for Vapor & 60 ft. above Sea.	Barometer. Highest corrected.		Barometer. Lowest corrected.		Thermometer. Mean	Thermometer. Mean Night	Thermometer. Mean Day	Thermometer. Coldest. Night.		Thermometer. Coldest. Day.		Thermometer. Hottest. Night.		Thermometer. Hottest. Day.		Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.	Rain. includes Snow. Inches.	Rain. Days.	Snow. Inches.	Snow. Days.	Nights of Frost.	Degrees Frost.	Below Zero.	Rimy Frost.	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows.	Auroras.	Halo 2d Sun.	Halo 2d Moon.	Corona.	Wind. Turned. With Sun.	Wind. Turned. Against Sun.	Wind. True N. S. to W.	Wind. True N. W. N.	Wind. True N. N. E.	Wind. True N. E. S.
January	29.9903	29.8920	30.560	1	28.562	30	26.50	21.0	32.0	7	10	13	14	38	4	50	18	.1583	77.3	4.023	712690	19.16	6.550	18	23.25	13	30	304	...	3	1	..	2	..	...	10	5	2	...	2	1	11	7	7	6
February	29.8004	29.7259	30.502	18	28.460	1	22.50	17.0	28.0	–2	5	6	4	36	25	41	25	.1345	77.7	3.420	563730	16.78	7.605	13	23.25	9	27	421	1	3	1	6	7	...	...	6	3	2	...	4	...	6	9	6	7
March	29.6929	29.6199	30.468	27	29.009	18	26.70	22.4	31.0	–2.5	13	13	12	30	30	44	2	.1339	72.0	3.403	910440	24.47	3.980	9	36.50	9	31	309	2	6	...	..	3	..	...	11	1	1	...	..	...	5	13	10	3
April	29.9739	29.8431	30.534	16	29.326	13	35.75	29.7	41.8	20	17	29	16	41	13	64	11	.1908	69.1	4.847	581300	16.15	3.870	13	.75	1	25	100	...	6	...	1	11	1	...	13	5	2	...	5	...	5	6	16	3
May	29.8400	29.6739	30.310	31	29.397	4	40.90	33.6	48.2	22	6	34	5	54	30	69	31	.2261	67.0	5.744	512960	13.79	1.705	10	4.25	4	18	55	...	7	2	...	9	...	...	9	3	...	1	1	1	5	8	13	5
June	29.8899	29.5944	30.196	9	29.369	22	53.85	47.0	60.7	33	4	48	12	63	15	81	1	.3555	70.4	9.032	511120	14.19	2.475	11	....	...	2	......	...	2	2	...	7	6	...	9	5	...	...	5	1	10	5	7	8
July	29.8333	29.4185	30.101	5	29 534	25	64.10	55.5	72.7	39	3	57	1	69	9	89.5	24	.4748	67.0	12.060	592100	15.91	2.120	9	....	...	1	......	...	1	...	...	3	2	1	9	3	...	...	6	...	15	6	5	5
August	29.8348	29.3843	30.066	8	29.465	6	63.35	56.7	70.0	45	7	59	24	67	11	83	1	.5105	72.9	12.969	578420	15.55	3.310	14	....	...	...	......	...	. .	1	...	4	8	2	9	2	...	...	4	...	13	10	2	6
September	29.9264	29 6013	30.370	30	29.333	4	54.25	48.2	60.3	35	9	46	30	63	5	75	5	.3851	72.2	9.183	649020	18.03	6.575	11	....	...	3	....	...	3	...	...	3	...	1	9	1	1	1	6	...	12	8	8	2
October	29.8746	29.6530	30 420	24	29.304	21	46.00	40.8	51.2	28	28	36.5	27	60	14	68	12	.2816	77.3	9.153	782810	21.00	6.195	12	.50	2	6	5	...	4	3	...	3	...	4	7	4	1	...	1	1	12	14	1	4
November	29.7267	29.5653	30.489	22	28.976	13	38.45	35.0	41.9	25	19	25	30	47	16	55	16	.2214	80.7	5.625	585930	16 27	9.065	20	4.25	5	14	39	...	4	1	...	4	...	4	5	...	1	1	2	...	11	8	3	8
December	29.6288	29.5318	30.357	12	28.905	15	28.65	24.7	32.6	10	25	17	25	39	11	49	29	.1570	84.8	3.989	637150	17.13	9.175	20	9.25	13	26	266	...	8	...	1	5	...	...	5	2	2	1	2	3	18	5	7	1
Mean	29.8433	29.6251	. ....		......		41.75	35.9	47.5	...		....		..		....		.2691	74.0	6.787	634806	17.40	.. ..	13.3	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	....	....	...	..	...	..
Extreme	....	....	30.560	Jan 1	28.460	Feb 1	. ....	....	.. .	–2.5	Mar 13	6	Feb 4	69	Jly. 9	89.5	Jly. 24	....	....	......	7617670 or 152353	.... Miles	62.625	160	102.0	56	183	1499	3	47	11	8	61	17	12	102	34	12	4	38	7	123	99	85	58

COMPARED WITH THE ABOVE.

	Corrected to 32°.	Correc. for Vapor	Highest corrected.		Lowest corrected.		Mean	Mean Night	Mean Day	Coldest Night		Coldest Day		Hottest Night		Hottest Day		Force of Vapour in inches	Relative Humidity	Force of Vapour in mm	Revolutions of Wind	Miles per hour	Rain Inches	Rain Days	Snow Inches	Snow Days	Nights of Frost	Degrees Frost	Below Zero	Rimy Frost	Hail	Silver Thaw	Fogs	Light'g & Thun.	Rainbows	Auroras	Halo 2d Sun	Halo 2d Moon	Corona	With Sun	Against Sun	S. to W.	W. N.	N. E.	E. S.
1867.																																													
Mean	29.8524	29.6704	......	Feb.	.....	Sep.	40.06	34.17	45.95	..	Jan.	....	Dec.	..	Aug	....	Aug	.2438	72.87	6.194	643534	17.6	4.841	12	....	...	...	....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Extreme	....	....	30.768	11	28.676	30	.....	....	.....	—10	31	1	31	67	25	85	9	.....	. ...	......	7722414 or 154448	Miles	58.090	147	125	52	172	2171	7	23	5	5	25	9	6	26	16	3	0	36	17	122	114	54	75
1868.																																													
Mean	29.8854	29.6924	......	Mar	.....	Feb.	39.29	33.64	44.84	....	Feb.	....	Feb.	..	July		July	.2454	74.30	6.233	675908	18.5	4.975	12 5	94.5	65	193	2486	15	18	6	3	28	12	6	35	23	7	2	35	5	129	107	76	54
Extreme	....	......	30.611	6	28.809	6	.....	......	.....	—13	4	4	22	66	2	89	5	....	.....	......	8110903 or 162218	Miles	59.750	152	.....	..	...	....	...	...	...	...	...	...	...	...	...	...	...	....	....	...	...	..	..
1869.																																													
Mean	29.8413	29.6325	... ..	Dec.	.... .	Feb.	40.80	34.43	47.17	....	Jan.	....	Jan.	..	Sep	....	July	.2696	68 10	6.894	612927	16.8	5.041	11.7	91.75	48	186	1794	6	37	8	6	41	6	7	39	27	6	3	36	9	124	104	81	56
Extreme	....	....	30.590	11	28.886	4	.....	.....	.....	— 9	23	1	23	69	9	86	29	....	.....	......	7355130 or 147102	Miles	60.490	140	.....	..	...	....	...	...	...	...	...	...	...	...	...	...	...	....	....	...	.	..	..

CLIMATE OF ALBION MINES, NOVA SCOTIA. Lat. 45° 34′ 30″ North. Long. 62° 42′ West. 120 feet above Sea.

	Corrected to 32°.	Correc. for Vapor	Highest corrected.		Lowest corrected.		Mean	Mean Night	Mean Day	Coldest Night		Coldest Day		Hottest Night		Hottest Day		Force of Vapour in inches	Relative Humidity	Force of Vapour in mm	Revolutions of Wind	Miles per hour	Rain Inches	Rain Days	Snow Inches	Snow Days	Nights of Frost	Degrees Frost	Below Zero	Rimy Frost	Hail	Silver Thaw	Fogs	Light'g & Thun.	Rainbows	Auroras	Halo 2d Sun	Halo 2d Moon	Corona	With Sun	Against Sun	S. to W.	W. N.	N. E.	E. S.
10 years	29.7137	....	30.757		28.505		41.97	33.11	50.91	—22						98							44.967	173	111.5	63	189	2470	19					19								112	126	66	61

TABLE No. 2.

RAIN-FALL COMPAREDs

Year.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Septr.	Octr.	Novr.	Decr.	Total.
1867	5.915	3.395	5.965	5.085	5.370	2.010	3.080	2.560	11.265	2.920	4.780	5 745	58.090
1868	4.665	5.545	3.945	5.320	3.145	6.057	2.122	3.428	6.956	7.745	5.700	5.120	59.750
1869	3.610	5.820	6.005	4.420	7.400	5.300	6.400	2.725	2.870	7.220	5.065	5.655	60.490
1870	6.550	7.605	3.980	3.870	1.705	2.475	2.120	3.310	6.575	6.195	9.065	9.175	62.625
Mean	5.185	5.591	4.974	4.674	4.405	3 460	3.431	3.006	6.916	6.020	6.152	6.424	60.237
1867	10	5	11	7	8	1	4	2	12	3	6	9	
1868	5	8	4	7	2	10	1	3	11	12	9	6	
1869	4	8	9	5	12	3	10	1	2	11	6	7	
1870	8	10	6	5	1	3	2	4	9	7	11	12	
Mean	7	8	6	5	4	3	2	1	12	9	10	11	

1 quarter—March, April, May	14 053	First half-year 23.949	Year 60.237
2 " June, July, August	9.896		
3 " September, October, November	19.088	Secood half-year 36.288	
4 " December, January, February	17.200		

HENRY POOLE,
Caledonia Mine, Cape Breton.

Other phenomena noted at this station :

January 27th.—A two year old seal shot at Big Glace Bay.

February 3rd.—Sleighs travelled over Big Glace Bay Lake. 5th.—First drift ice passing southward.

March 17th.—Wild geese at Lingan.

April 1st.—Great numbers of lobsters driven on shore at Little Glace Bay. 2nd.—Grey birds seen. 3rd.—Robins. 5th—Whistling duck heard. 10th.—A large moth seen. Herrings caught on the 12th. 21st.—Codfish thrown ashore. 23rd.—Mayflowers in bloom. 26th.—Heard yellowhammer, woodpecker, picres auratus? 27th.—Gaspereaux caught in Big Glace Bay; and frogs piping. 30th.—Saw four humble bees, butterfly, "Camberwell Beauty;" heard a partridge drumming.

May 7th.—Saw a small hawk; blue herons, "Ardea Herodias," and yellow-legs, "Totanus flavipes." 10th.—A porpoise came on shore at Glace Bay. 21st.—Wild strawberries, white violets and coltsfort, "Nardosinia palmata," bloom. 24th.—Alder catkins blossom. 28th—Swallows seen. 29th.—Dandelions bloom. 31st.—Musquito hawk seen.

June 4th.—Swallow-tailed butterfly (*Papilio turnus,*) seen. 5th.—White and Sulphur butterflies, (*Pontia olerace et Colias Philodice*). 11th.—Wasps. 12th.—Apples in blossom. 17th.—Caplin "mallotus villosus," struck in at Mire. 24th.—Caplin at Big Glace Bay. 29th.—Gathered ripe strawberries.

July 6th.—Fireflies seen. 14th.—Dragon fly. 16th.—Potatoes and wild roses in blossom. 21st.—Mowed hay. 26th.—Saw a bat. 29th.—Gathered peas and dug potatoes.

August 16th.—Golden plover arrived.

September 20th.—Sword fish seven feet long thrown on shore at Big Glace Bay. 21st.—Six wild geese in the Bay.

October 9th.—A lunar halo with paraselene from 8 to 10 P.M. 27th.—First frost.

December 31st.—A flock of wild geese in Big Glace Bay.

APPENDIX.

FIELD EXCURSION,
June 21st, 1871.

ABOUT twenty members, with their friends, met at the Steamboat wharf and proceeded to Dartmouth in the 2 P.M. boat. They were then conveyed to the Montague Gold Mines, about seven miles distant from Dartmouth.

The day was beautiful and pleasant, and the Company enjoyed themselves exceedingly. The road going from Dartmouth, passing along the chain of lakes exhilarated the spirits and gladened the hearts by the ever changing and quiet scenery. The road from the highway to the mines was found to be rather rough, but by no means unpleasant.

Arrived at Montague we had ample material for geological speculation. Dr. Honeyman defined the position, &c. of the strata, which at first seemed somewhat perplexing. Walter Lawson, Esq. C. E. the proprietor of one part of the mines and a successful worker of them, very kindly conducted the party through the mines. Mr. Brown kindly explained the processes of crushing, amalgamating, and retorting, which was quite a novelty to many of those present.

The company were afterwards entertained by Mr. Lawson with refreshments, and then returned to the city highly delighted and instructed by the excursion.

W. G.

NOTES ON THE MONTAGUE GOLD MINES.

HAVING been honored by the Institute with the post of guide in the Montague Gold Field, before having made an examination of the locality I proceeded to make some little preparation for the work assigned to me. I tried to ascertain the position of the Montague Mines by examining the only geological map of the Gold Mines in my possession, and there found that the mines in question were situated east of the Richmond station of the Nova Scotia Railway. I therefore came to the conclusion that it was probable that the gold-containing rocks were a continuation of the argillites and quartzites of the section at the station, *i. e.*, the north side of one of synclinals or south of one of the anticlinal folds of the lower silurian strata of the Halifax peninsula. I also asked W. A. Hendry, Esq., Deputy Commissioner of Crown Lands to locate the Montague district on one of the office maps. The position which he assigned to it tended to confirm the conclusion at which I had arrived.

I was therefore somewhat astonished, when we found ourselves advancing so much to the north of the narrows of Halifax harbor; still I expected that by changing the direction of our road we might come so far south as to arrive at the expected position. I was, however, disappointed and my foregone conclusion became valueless. We found ourselves transported to Montague, in a locality some miles to the north of its supposed position.

The metamorphic lower silurian strata of Montague are quartzites with interstratified argillites having auriferous quartz veins conformable with the bedding and also intersecting it. The lode or lead conformable with the stratification called the Belt lead, is the seat of the principal works. This is found to be the richest gold-producing vein in the locality. There are also works on a cross lead, from which a very beautiful and rich mass was exhibited at the time of our visit. The strata containing these have a southerly dip, being on the south side of a synclinal, which, if continued westerly would intersect the section of rocks at the railway on the west side of Bedford Basin, about two miles north of Halifax.

Mr. Lawson pointed out to me the position of an anticlinal axis to the south of the mines.

Our visit was too cursory to enable us to ascertain details of structure. I looked for fossils but found none. I observed in the argillites, concretions such as are frequently found in argillite strata, and which have often an organic nucleus. I expect to return to the locality, for the purpose of making a better investigation.

This Gold Field is at present one of the most productive of the Gold Fields in the Province. The persevering operations of Mr. Lawson have been rewarded with distinguished success. He explained to me his system of mining; there is no groping in the dark; the product of every shaft is kept distinct; the exact amount of gold produced by each is known so that the comparative productiveness of each is manifest; the whole working is carefully measured and planned. The works are superintended by Mr. Lawson himself.

There is much mispicked or arsenical pyrites associated with the gold in the quartz vein: the result of this is that a great part of the gold escapes in the process of crushing and amalgamating, by the sickening of the mercury. Among all the methods proposed for remedying this evil, there have been none found adequate to meet the case. The cost of all exceed the profit; the tailings when exposed to atmospheric action become partially oxidised and cemented together by the oxide of iron. It is to be hoped that some means will now be discovered by the energetic proprietor of the mine by which the evil may be remedied, and the precious metal recovered.

D. H.

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE, HALIFAX, NOVA SCOTIA.

PATRON—His Honor the LIEUTENANT-GOVERNOR.

COUNCIL, 1870-1.

[illegible] M. JONES, ESQ., F. L. S., *President.*
[illegible] GILPIN, ESQ., M. D., M. R. C. S., } *Vice Presidents.*
PR[illegible] LAWSON, Ph. D., L. L. D., }
W. G[illegible], ESQ., *Honorary Secretary.*
W. C. SILVER, ESQ., *Treasurer.*

J. RUTHERFORD, ESQ., M. E.,
FRED. ALLISON, ESQ.,
J. R. DEWOLFE, ESQ., M. D.,
H. MOODY, ESQ.,
REV. D. HONEYMAN, D.C.L., F.G.S., &c.,
ANGUS ROSS, ESQ.,
P. S. HAMILTON, ESQ.,
JOS. BELL, ESQ.

The Anniversary Meeting of the Institute is held on the *second Wednesday* in October, of every year.

The Monthly Ordinary Meetings of the Institute, when Papers are read, are held on the second Monday evening in every month, commencing in November and ending in May.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. III. 1871-72. PART II.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 87 GRANVILLE ST.
ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.
UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.
1872.

Price, Five Shillings.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL III. PART II.

Provincial Museum, Oct. 11th, 1871.

ANNIVERSARY MEETING.

J. M. JONES, ESQ., F. L. S. *President, in the Chair.*

Inter alia.

The following officers were elected by ballot:

President—J. M. JONES, ESQ., F. L. S.

Vice Presidents—BERNARD GILPIN, ESQ., M. D., M. R. C. S., and G. LAWSON, Ph. D., L. L. D.

Secretary—REV. D. HONEYMAN, D. C. L., F. G. S., &c.

Treasurer—W. C. SILVER., ESQ.

Council—FRED. ALLISON, ESQ., — WESSELHOFT, ESQ., M. D., J. R. DEWOLFE, ESQ., M. D., J. RUTHERFORD, ESQ., M. E., H. MOODY, ESQ., W. GOSSIP, ESQ., J. BELL, ESQ., ANGUS ROSS, ESQ.

ORDINARY MEETING, NOVEMBER 13, 1871.

DR. GILPIN, *Vice President, in the Chair.*

Inter alia.

The Secretary announced that Prof. J. Cope, President of the New Orleans Academy of Science, Dr. W. O. King, Vice President of the same Institution and Jules Marcou, Esq., had been duly elected by the Council, as corresponding members.

The Secretary then read a paper by the President, "*On a Lophioid Fish recently caught off Halifax;*" and also one by himself, entitled, "*Strictures on Logan and Hartley's Geology of the Pre-Carboniferous Rocks of the Pictou Coal Field.*"

ORDINARY MEETING, DECEMBER 11, 1871.

DR. GILPIN, *V. P., in the Chair.*

Inter alia.

The Secretary announced that the Council had duly elected as members, the Hon. Wm. Garvie, T. J. Egan, Esq., D. Blackwood, Esq., Capt. Tulloch,

H. M. 61st Regt., Dr. A. P. Reid, the Rev. Dr. Warren, James Whitman, Esq.; and as corresponding member, the Rev. T. Ball, of Prince Edward Island.

A paper "*On the Moose,*" was read by Dr. GILPIN, Vice President. This is the last of the series on the Mammalia of Nova Scotia.

ORDINARY MEETING, JANUARY 8, 1872.

DR. GILPIN, *V. P., in the Chair.*

Inter alia.

A paper "*On Parallel lines of Elevation in the Earth's crust,*" was read by ANGUS ROSS, Esq.

ORDINARY MEETING, FEBRUARY 12, 1872.

DR. GILPIN, *V. P., in the Chair.*

Inter alia.

The Secretary announced that the Council had duly elected as members, the Rev. A. S. Hunt, Robert Morrow, Esq., Walter Lawson, Esq., C. E., James Foster, Esq., and Adam McKay, Esq., Engineer; as associate member, Alexander McKay, Esq., Dartmouth; and as corresponding member, Prof. James Tennant, F. G. S., F. Z. S., &c.

Dr. LAWSON then read a paper on the "*Naturalization of European Senecios in Nova Scotia.*"

The Secretary also read a paper "*On the Geology and Palæontology of the Pictou Coal Field.*"

ORDINARY MEETING, MARCH 11, 1872.

DR. GILPIN, *V. P., in the Chair.*

Inter alia.

The Secretary announced that ANDREW MOONEY, Esq., had been duly elected by the Council as a member of the Institute.

Mr. ALLISON read a paper on "*Meteorology of Caledonia Mines, Cape Breton,*" by H. POOLE, Esq., M. E.; also Notes of Travel in the Rocky Mountains, by HENRY S. POOLE, Esq., F. G. S., communicated by HENRY POOLE, Esq., M. E.

Dr. A. P. REID also read a paper "*On the Solar Chromosphere.*"

DR. GILPIN then read "*Notes on a Beaver Dam in the County of Digby.*"

ORDINARY MEETING, APRIL 8, 1872.

DR. GILPIN, *V. P. in the Chair.*

Inter alia.

The Secretary announced that E. Moseley, Esq., of Cape Breton had been duly elected by the Council as an associate member.

DR. COGSWELL read a paper "*On the Comparative Anatomy and Pathology of the Human Teeth.*"

The Secretary read a paper "*On the Geology of the Iron Deposits of Pictou County.*"

Dr. Lawson read a paper by Prof. How, D. C. L., entitled, "*Notes on Nova Scotian Botany.*"

Ordinary Meeting, May 8, 1872.

J. M. Jones, Esq., *President, in the Chair*,

Inter alia.

The Secretary intimated that J. W. Longley, Esq., and J. J. Stewart, Esq. had been duly elected by the Council as members of the Institute.

Mr. Fred. Allison read a paper "*On the Meteorology of Halifax.*"

The President gave some observations "*On Bermuda Natural History,*" made during his recent visit to Bermuda.

D. Honeyman,
Secretary.

LIST OF MEMBERS.

Date of Admission.			
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.
1871.	Nov.	29.	Blackwood, David, Halifax.
1864.	Nov.	7.	Brown, C. E. Halifax.
1867.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
1868.	Sep.	28.	Collins, Brenton, Halifax.
1871.	April	4.	Compton, William, Halifax.
1872.	April	12.	Costley, John, Halifax.
1863.	May	13.	Cramp, Rev. Dr., Wolfville.
1870.	Mar.	30.	Day, Forshaw, Artist, Halifax.
1863.	Oct.	26.	DeWolfe, James R., M. D., Edin., L. R. C. S. E., Dartmouth
1863.	Dec.	7.	Downs, Andrew, *Cor. Memb. Z. S.*, Halifax.
1871.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
1865.	Oct.	4.	Fleming, Sandford, C. E., *Chief Engineer Dom. Railways*, Halifax.
1872.	Feb.	12.	Foster, James, Barrister-at-Law, Halifax.
1863.	Jan.	5.	Fraser, R. G., Mineralogist, Halifax.
1871.	Nov.	29.	Garvie, Hon. Wm., *Chief Commr. of Mines and Works*, Halifax.
1863.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., VICE 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.
1866.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., &c., SECRETARY, Halifax.
1868.	Nov.	2.	Hudson, James, M. E., *Superintendent Albion Mines*, Pictou.
1872.	Feb.	5.	Hunt, Rev. A. S , *Superintendent of Education*, Halifax.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., PRESIDENT, Halifax.
1866.	Feb.	1.	Kelly, John, *Deputy Chief Commissioner of Mines*, Halifax.
1864.	Mar.	7.	Lawson, Geo., Ph. D., L. L. D., VICE PRESIDENT, *Prof. of Chem. and Natural History*, Dalhousie College.
1872.	July.	5.	Lawson, Walter, C. E., Montague Gold Mines.
1871.	April	4.	Leitch, A., H. M. Dock Yard.
1872.	May	1.	Longley, J. W., Halifax.
1869.	Dec.	3.	Moody, Harry, *Pri. Sec'y. of His Honor the Lieut. Governor* Sir Hastings Doyle.
1872.	Feb.	12.	McKay, Adam, *Engineer*, Dartmouth.
1872.	Mar.	2.	Mooney, Andrew, Halifax.
1866.	Feb.	3.	Morrow, James B., Halifax.
1872.	Feb.	13.	Morrow, Robert, Halifax.
1868.	Nov.	25.	Morley, Lieut. R. A.
1870.	Jan.	10.	Murphy, C. E., Halifax.

1865.	Aug.	29.	Nova Scotia, the Rt. Rev. Hibbert Binney, D.D., Lord Bishop of.
1863.	Jan.	5.	Poole, Henry, M. E. *Caledonia Mine*, Cape Breton.
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.
1868.	Dec.	29.	Roue, John, Halifax.
1869.	June	27.	Ross, Angus, 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, J. J., Halifax.
1865.	April	20.	Smithers, George, Halifax.
1867.	Aug.	16.	Tobin, Stephen, M. P., Halifax.
1871.	Nov.	29.	Tulloch, Capt. H. M. 61st Regiment.
1871.	Nov.	29.	Warren, Rev. Dr., Halifax.
1871.	Nov.	29.	Whitman, James, Halifax.
1864.	May.	16.	Whytal, John, Halifax.
1870.	Mar.	30.	Wesselhoft, Dr.
1866.	Mar.	18.	Young, *Sir* William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6	Ambrose, Rev. John, A. M., Digby.
1870.	Oct	27.	Elder, Rev. Prof., Acadia College, Wolfville.
1868.	June	13.	Ford, Alfred S., London, England.
1864.	July	1.	Marett, Elias, St. John's, Newfoundland.
1872.	Feb.	5.	McKay, Alexander, *Principal of Schools*, Dartmouth.
1865.	Dec.	28.	Morton, Rev. John, Trinidad.
1872.	Mar.	27.	Moseley, E. T., *Barrister-at-Law*, Cape Breton.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. T., Charlottetown, Prince Edward Island.
1868.	Nov.	25.	Bethune, Rev. J. S., Ontario.
1866.	Sept.	29.	Chevalier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1871.	Nov.	1.	Cope, Prof. J.C., PRESIDENT of the 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 PRESIDENT of the New Orleans Academy of Science.
1872.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., Mineralogist to H. M. the Queen, London, England.

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I. REVIEW OF NOVA SCOTIAN DIURNAL LEPIDOPTERA. BY J. MATTHEW JONES, ESQ., F. L. S.

PART II.

IN presenting this concluding part of my paper upon the diurnal lepidoptera of Nova Scotia, I have to remark in the first place the typographical errors that unfortunately occurred in several parts of the previous one published in the transactions of the past year. Owing to my absence in the Bermudas during the time when it passed through the press I had no opportunity of correcting the proofs; hence the unavoidable mistakes.

Debis Portlandia, (Fabr.)
Satyrus Portlandia, (Bois.)
Hipparchia andromacha, (Hubn.)

Of this rare species Mr. Belt secured two specimens near Elmsdale. It appears to be a southern form, but strange to say while authors declare it to be rare in the middle States of America, and in Upper Canada, D'Urban states it to be abundant north of the Ottawa, in the valley of the Rouge; and here we have it also in a latitude about as far north.

Erebia nephele, (Kirby.)

This butterfly quite unknown near Halifax, is very abundant about Annapolis, in the western part of the province, where in the latter part of July I found it on the flowers of the common thistle (*Cirsium lanceolatum*, Scop.) This genus of Dalman before included in that of *Hipparchia* is northern in its range, the several species known on the North American continent reaching a very high latitude even to the arctic coast.

Satyrus alope, (Fabr.)
Hipparchia alope, (Boisd.)

I found this species frequenting the thistle flowers near Annapolis in company with the former species. It was quite as common, if not more so than that species. Mr. Scudder of the Boston Natural History Society, has published a short paper upon the various plants on which the larvæ of the diurnal lepidoptera feed, in which this and *Erebia nephele* are put down as grass and sedge feeders. The sedge and rank grasses being very abundant in the marshy tract east of Annapolis, may therefore account for my finding the species so common there.

Neonympha Boisduvalii.

This is the most recent addition to my collection. It was taken by Mr. John Winton at Lower Stewiacke, Colchester Co.

Thecla nipha, (Hubn.)

Mr. Belt states that this species is not uncommon in dry, sheltered places in May. I have not been fortunate enough to take a specimen as yet. It appears to be a southern form being found more abundantly in Georgia and Florida.

Thecla augustus, (Kirby.)
T. augustinus, (West.)

I insert this species also on the authority of Mr. Belt, who says it is common on dry shrubby banks, and when pursued falls among the herbage. I have more than once endeavoured to capture a species of *Thecla* which frequents the bushy slopes near the shore at Point Pleasant, but from its extreme shyness I have never yet succeeded. It is probably, from appearance, either this or the previous species.

Argus pseudargiolus, (Boisd.)
Polyommatus pseudargiolus,
Lycæna pseudargiolus.

Mr. Belt includes this species in his list, stating that it is common in May and June, and that a second brood appears in July and August. It is one of the small blue butterflies.

Polyommatus lucia, (Kirby.)

This is a rather common species about Halifax, making its appearance about the first or second week in May. It is very similar in size and markings to the previous species, but the dark border on the fore wings of the female of *pseudargiolus* is not so wide.

Polyommatus Americana, (D'Urban.)
Lycœna Americana, (Harris.)

Harris I believe first drew attention to the difference of markings between this and the small copper butterfly of Europe, Asia, and Africa, (*Lycœna phleas*, Fabr.) and raised it to rank as a distinct species. The markings are very dissimilar when carefully viewed, although it would be hard to say that this species had not originated in the foreign form or *vice versa*. It differs more particularly from the European species in being of less size and having the black spots on the fore wings much larger and well defined.

Harris (Insects injurious to vegetation, 2nd edit. p. 274) states that the wings of this species are not notched or tailed. In my Nova Scotian examples they are clearly so, having an indentation at the extremity of the hind wings, one of the points of which is an immature tail.

It loves to keep on the sides of roadways, where it alternately rests upon the little flowers and the hot ground, opening and shutting its wings as if in full enjoyment of its short life. Should another of its fellows venture to approach too near its favourite haunt, or indeed one of the larger butterflies, it immediately flies at the intruder, and a regular battle ensues in mid-air, our little friend generally coming off conqueror. It does not appear very early in summer, but may be seen about as late as September on clover and other blossoms of the field. The caterpillar of this species feeds upon the common dock.

Polyommatus porsenna, (Scudder.)

This species of which I have only seen one specimen is very rare, at least about Halifax, and Mr. Belt found it equally so about Waverley and Portobello on the Dartmouth side. It is a southern species. The caterpillar feeds upon the hawthorn (*Cratægus.*)

Fam. HESPERIDÆ.

Nisoniades brizo, (Boisd.)
Thanaos brizo, (Har.)

This is a common species about Halifax, to be found on open barrens as well as shady spots in the forest. I have observed it to be numerous in barrĕn places on the blossoms of the blueberry about the end of June. Morris in his N. American Lepidoptera sets it down as an inhabitant of the Southern States, but it is clearly as abundant in our northern latitude as anywhere else.

Hesperia hobomok, (Har.)

Common in old roadways in the forest during the summer months.

Hesperia mystic, (Edw.)

Not quite so common as the preceding species in similar situations.

Hesperia Peckii, (Kirby.)

Rather less numerous than the other species.

Three other species in my cabinet yet undetermined.

Art II. Note on a small and remarkable Lophioid recently taken off Halifax Harbor. By J. M. Jones, Esq., F. L. S.

(*Read Nov.* 13, 1871.)

A few weeks ago Dr. Honeyman kindly drew my attention to a singular looking little fish which had been taken at the mouth of Halifax Harbour by a fisherman, and placed in the Museum. At first sight it appeared to me to belong to the *Triglas* or Gurnards from the appearance of the pectorals, which are so particularly developed, but on looking for the three detached rays at the base of these fins and finding them absent, I at once concluded that it could not be placed in that genus. Finding it impossible to recognize the specimen as belonging to any particular genus, although it approached more nearly that of *Lophius* than any other, I thought it best to communicate with Dr. Theodore Gill of Washington, who is the chief authority on American fishes, and sent him a sketch of the fish accompanied by the following description :—

Characteristics.—Head very large, high, compressed, cleft of mouth horizontal and very wide. Jaws with cardiform teeth. Body naked, attenuate, compressed. Head armed with stout sharp spines. Total length, 2 inches 4 lines. Pectorals with carpal bones slightly prolonged ventrals in advance of pectorals.

Description— Length of head ....9 lines.
Depth ....$6\frac{1}{4}$ "
Width ....$4\frac{1}{2}$ "
Length of snout ....$4\frac{3}{4}$ "

Lower jaw longer than upper, flattened beneath, shovel-shaped, as if formed to rest upon, with a single row of cardiform teeth. Upper jaw, with maxillaries and intermaxillaries armed with similar teeth. Tongue elevated, with a few small teeth on its surface extending to the root. Nasal bones armed at their extremities with two minute spines. Orbital crests armed with three acute spines each occiput with two larger ones. Two small spines also occur at the posterior basal angle below the pectorals. Frontal, from occiput to snout, flattened with a medial ridge extending from the snout a little beyond the orbital line. On the summit of the head is a flexile filament, $3\frac{1}{4}$ lines long; at $1\frac{3}{4}$ lines from this commences the first dorsal of three flexile rays, the first $4\frac{3}{4}$, the others somewhat less. These rays are connected by thin membrane for about one third their extent. The second dorsal is 4 lines from the first and is composed of nine rays of the nearly equal length of $3\frac{1}{2}$ lines. Pectorals, with carpals slightly prolonged, of nine branched rays, originating in the bony cheek a short distance above the posterior basal angle, extending the whole length of the body, exclusive of the caudal, and half as broad as long when distended. Ventrals, of five rays, springing 6 lines from extreme of lower jaw, and $1\frac{1}{2}$ lines anterior to the vertical of the pectoral base. Anal, of nine rays, (5, 6, 7, longest) distant from ventrals $6\frac{3}{4}$ lines and terminating $1\frac{1}{4}$ lines from caudal base ; caudal, of eight rays obtusely lanceolate, the centre rays six lines in extent. Eyes, $1\frac{1}{4}$ lines diameter, blue, having the pupil of a silvery tint ; gill openings, small foramens, immediately behind the pectoral base.

Colour.—Above, bluish-black, caused by a congregated mass of dark speckles ; beneath, light horn colour, mottled more or less with similar speckles ; dorsals, pectorals, ventrals, and anal bluish-black ; caudal, dirty white.

Dr. Gill's reply was as follows :—

I recognize in the figure sent the young of *Lophius Americanus* (as I think it must be) but it seems that you have overlooked the two anterior dorsal rays and miscounted the pectorals. Have you not also observed some minute filaments or tags on the head and body?

Now, as regards the two anterior dorsal rays and the tags alluded to, I have little hesitation in saying that they are absent in this specimen, and as the fish was in a very fine state of preservation when I examined it, I do not think such processes could have been rubbed off in any way. Another feature tells against its being the young of *Lophius*, viz. the great elevation of the head which does not correspond with the dimensions of young Lophioids of similar size given in Günther's Catalogue. For the present therefore, and until my return from the Bermudas I must leave the matter unsettled, intending to include this and several other forms in a more extensive paper I hope (D. V.) to lay before the Institute next year.

I must not omit, however, while on the subject of Lophioids, to notice the fine specimen of *L. piscatorius*, or what our American friends are pleased to call *L. Americanus*, (although it has no claim whatever to be considered a distinct species from the European form), recently taken at the Dockyard, and now under process of being skeletonized at the Lumber yard for presentation to the Museum, by Capt. Tulloch, R. E.

The pectoral fins of the Lophioids are very singularly formed, as may be seen by looking at a skeleton prepared by Dr. Honeyman, serving the purpose of arms to rest upon while the fish remains stationary on the look out for prey.

ART. III. ON PRE-CARBONIFEROUS ROCKS OF THE PICTOU COAL FIELD. BY THE REV. D. HONEYMAN, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

(*Read Nov.* 13, 1871.)

ABSTRACT.

IN the Report of Progress of the Canadian Survey, from 1866 to 1869, page 7, Sir W. G. Logan says in reference to certain pre-carboniferous rocks underlying the Pictou Coal Field, "No evidence was observed by me on McLellan's Mountain to shew 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 considered them to be of Devonian age, and on his authority they will be so distinguished."

I presume that this language is intended to apply to the area indicated on the S. E. corner of the map which accompanies Sir W. Logan's Report, which is distinguished by the Devonian colouring. Now, this area has its N. E. corner at the Falls of Sutherland's River, and its S. E. corner at the bridge at McPherson's mills, so that in addition to the Northern part of McLellan's Mountain (range) the area in question includes also a part of Sutherland's River.

In my last paper read before the Institute, "On the Pre-Carboniferous Rocks underlying the Pictou Coal Field," I concluded thus: "It may seem strange that I have made no mention of the Devonian formation which is so often spoken of in connection with the strata underlying the Pictou Coal Field. The reason why is this—there is no Devonian to be found there."—*Transactions* 1870–71.

This language was made to apply to the supposed Devonian Rocks of Sir W. Logan's report, as well as to the others.

The evidence upon which Sir W. Logan bases his conclusion, is lithological, in the supposed absence of stratigraphical and palæontological evidence.*

The conclusion at which I had arrived was altogether based on palæontology and stratigraphy.

I had occasion to examine the area in question about a year after Sir W. Logan's examination. I had often cursorily examined the locality, and picked up Silurian fossils in it, so that I had for years been convinced that the prevailing rocks were of Silurian age. On this occasion, however, I made a careful and thorough examination, and was rewarded with many important discoveries. In the area in question we have, 1. Quartzites and argillites of the northern part of McLellan's Mountain. These are so highly metamorphic that I considered it useless labour to search for fossils in them. Besides coming upon them from the south, I had no

*Note—In reference to this kind of evidence, Prof. Dana well observes that in the absence of Stratigraphical and Palæontological evidence "Lithology may give us guesses but nothing more substantial." *Nature No.* Feb. 12, 1872, page 331.

difficulty whatever in ascertaining their palæontological and stratigraphical relations. I have already shown that the rocks in question lie in the northern part of Anticlinal series No. 2. This series with the rocks of the Middle and Upper, or Clinton and Lower Helderberg of the E. side of Anticlinal series No. 1, constitute the whole of McLellan's Mountain range. I have also shown that the key localities of the series are at Blanchard, known from its bed of fossiliferous iron ore, and Simon Fraser's Mountain near the southern end of McLellan's Mountain. In the former locality I discovered fossils on either side of Anticlinal axis No. 2, proving that the rocks were altogether middle Silurian, with possibly a small addition of Lower Helderberg, Upper Silurian. At Simon Fraser's Mountain the rocks on the W. side of axis No. 2 are fossiliferous, while their counterpart on the E. side, are so highly metamorphic as to render the existence of fossils doubtful, although the stratigraphical relation is sufficiently obvious.

The fossiliferous strata occurs thus,—*ascending,* a broad band of Mayhill or Medina Sandstone, quartzites of normal thickness, with abundance of characteristic *Petraia* and *Cornulites*, (trumpet shaped,) then Clinton shales which are likely to produce fossils, although I did not succeed in finding any, and then the Lower Helderberg strata of McLellan's Brook, having abundance of characteristic fossils. The rocks in the northern part of McLellan's Mountain are a continuation of the metamorphic middle Silurian of the eastern side of Fraser's Mountain. The axis and the continuation of the fossiliferous strata on the western side extend to the north and become obscure. About half a mile beyond the Presbyterian Church of the mountain, the strata of the eastern side are seen outcropping on the plateau until they seem to terminate at McLean's Brook on the side of the mountain. This proves that the supposed Devonian Rocks of McLellan's Mountain are metamorphic Middle Silurian.

I stated formerly that the northern extremity of McLellan's Mountain is Blackwood's Mountain. This mountain chiefly consists of a great mass of greenstone. This forms the base of a monoclinal series which lies to the south of the mountain. At the foot of the mountain, S. side, is an outcrop of metamorphic slate apparently non-fossiliferous; this extends to the north east corner of the area and there terminates, forming the falls of Sutherland's River. This band is overlaid by shales having characteristic Clinton fossils in abundance, *e. g. Leptocoelia intermedia*, Hall. These strata are found at Cameron's Brook, and on the side of the old road, all being situated in the area in question. These supposed Devonian rocks, then, are also Middle Silurian. I would now turn to the south east corner of the area, and enter the area from that direction; we find the bridge built on strata containing lingulae *not* characteristic. These are abutted by Lower Carboniferous sandstone of the river bed. On the right side of the road at the miller's house the end of a trap dyke underlies the lingula strata; nearly half a mile from the bridge the same strata are seen outcropping on the right side of the road, and then passing over to the left side. On the right side we have the same greenstone dyke, and on the left abundance of orthids and other fossils characteristic of the lowest part of the A. or Medina strata of Arisaig, and then in an exposure of the same strata at the bridge of a tributary of Sutherland's River, Cameron's Brook, described by Sir W. Logan in page 6 of his report, I found several Petraia similar to these of Fraser's Mountain and Arisaig A strata. Following the course of this tributary towards Sutherland's River we have the same strata with Petraia reaching to the Falls: there they overlie the same greenstone dyke. This Medina band is overlaid and succeeded on the south by Clinton strata, in which we have the exact counterpart of the Lower Clinton B of Arisaig with its black shales, concretions and Lingula nodules. This shale is not included in the supposed Devonian area.

I would observe that the greenstone dykes referred to may be Devonian, as they are undoubtedly *post* Upper Silurian and *pre*-Carboniferous, so that with this possible exception the whole of Sir W. Logan's Devonian Rocks are of Middle Silurian age.

The fossils that I have referred to illustrative of the palæontology of these rocks, are in the Museum of the Canadian Survey, Gabriel Street, Montreal, and in the Provincial Museum, Halifax, and also my maps illustrating their stratigraphy.

ART. IV. ON THE MAMMALIA OF NOVA SCOTIA. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read December* 11, 1871)

Cervus alces, Linnæus, Richardson, Dekay, Audubon.
Alce americanus, Jardine, Baird.
Cervus orignol, Mons. Derville.
Cervus lobatus, Agassiz.
Alcès machlis, Ogilvy, Sclayter's list, Zoolog. Gardens, L'orignol, Cuvier.

THE MOOSE.

THE following description was taken from a very fine bull exhibited at Halifax about six years ago. Supposing he was dropt in May, he was then three years and four months old, and in full summer coat:—

He stood between six and seven feet high from the crest of his withers. His height about the length of his body from tip of moufle to tail. His head about the length of his depth from withers to brisket, and his legs about one and a quarter longer than this depth. It was evident at a glance that his great height was caused, as has long been remarked by writers, by the extreme length of the cannon bones (metacarpal and metatarsal) of the legs. These distances were only judged by the eye, but they were done carefully, and will serve for approximations. Mr. Downs informed me that a young bull owned by himself measured, when nearly completing his second year, five feet three inches at the withers. A cow calf measured by myself, (25th July, 1859,) about two months old, gave three feet six inches from top of withers, and four feet three inches from tip of nose to buttock.

In studying the form of the above-mentioned individual, we found the head very large, owing to the immense overhanging and prehensile upper lip, and huge inflated nostril, hairy with the exception of a naked patch of the size of a crown piece at its extremity. The forehead slightly convex, swelled directly to form a foundation for the horn, which here was the small trifingered third year horn. The ear was large and ovate with a fine tip. A fine bristly mane reached from betwixt the ears to beyond the withers. The back line from the croup to the withers ran nearly straight, but then rose rapidly, forming the withers, and sinking again on joining the head. The older figures give this line as rising rapidly from croup to withers, which is a mistake, as also Capt. Hardy's assertion that croup and withers are nearly equal: I think he means croup and head. In the cow-calf I measured there was three inches difference. Here I should think there was at least six. The loins though short are largely developed, the transverse processes of the lumbar vertebra being very long. The tail is small and deeply hidden betwixt the buttocks, which are slender and very cervine in their appearance. The hocks are flat but of great depth surmounting a cannon bone of great length. The brisket is of great depth, supported by a very powerful fore arm, which however has its muscle unlike the horse on its posterior rather than anterior surface ; the hoofs are small and polished, the animal standing on the tips with the hind tips well off the ground. The neck from the fore shoulder to the head is clothed by a dense coat of hair, which forms a mane from the chest along the neck to the chin, hidden in which and depending from betwixt the angle of the jaws hangs the "bell," a species of wattle, composed of muscle and skin, and covered with long hair resembling the brush of a fox. The eye is dark with little expression and set deep in its bony socket. The color of this bull was in the highest summer coating of deep glossy black, and short as a well groomed horse. The moufle and forehead had a brownish-yellow cast, the cheeks and neck dark balck ; the ears were light fawn inside, a little darker outside, the crest yellowish mixed grey and white, and a yellow grey patch upon the croup. The inside of the buttocks and all the legs both inside and outside were bright yellow fawn, the black of the body running down half way, to the hocks and to the knees, and ending with an abrupt line in a point. There was also a black line running from each hock and each knee in front, and widening to join the hoof. This line has heretofore escaped observers. Captain Hardy doubts it, and I can only maintain that it was so in this instance. We have but few opportunities of seeing the summer coating. It was recognized by the Indian chief James Mense when I showed him my sketches, and I have litle doubt may always be found. The winter coating is formed of long hair so stiff as to stand bristly outward, and as each hair is lead colored at base, greyish-white in the middle, and black at tip, the whole animal has a greyish appearance. The crest loses its yellowish wash, and the hair on the cheeks and neck is both darker and shaggier than on the body. There is still a yellowish brown wash upon the moufle, and forehead, and the ears are brownish fawn. The beautiful yellow fawn and black stripes of the legs disappear, and mixed grey cover them, hiding the abrupt lines of black and tan. This is the usual color as described by naturalists as he is usually taken in winter, when the bulls are hornless, the cows having none. In the bull calf of the first year two knobs swell out upon the forehead beneath the skin ; in the second year the true horn appears, a single prong six or eight inches long ; in the third year the new horn is usually trifingered, and a little flattened ; and in the fourth year assumes the adult form though small. The Indian and hunters say they increase till the eighth year. The horn of an adult bull springs at right angles from a broad knobby base on the forehead, throws off one, two, or three brow prongs on tines and then rapidly flattening reflects backwards nearly at right angles, forming a broad flattened palm, the anterior convex edge of which is subdivided into more or less numerous tines. There is some analogy between the number of these tines and the age of the owner, but not accurate enough for calculation. About seven or eight tines are the usual number. The largest pair of horns I have seen, measured five feet two inches in width, from tip to tip; the heaviest about fifty pounds. Their colour is brown with bright burnt sienna stains, and white edges to the tines. They shed them in February, and I have seen the young velvet horn in April. I have seen the young calves in June when they could not be ten days old; they were a lively fawn color, about two feet six inches in height, their heads small and not indicating future ponderance. They kneeled readily to drink or pick the grass; and I have seen them again between two and three months old, when they had rapidly grown to three feet six inches, their heads still small, but the neck and withers putting on a dark shaggy look, and the fawn tints becoming greyer. They usually all die when taken from their dams, and are scarcely saved by being put to domestic cows.

Such is the description of this great boreal deer, that frequents our pine forests, his most southern range. In early spring the cows seek the densest cover, very usually the islands in our woodland lakes, or the higher spots of our swampy barrens, to bring forth their young, the bulls meanwhile frequenting the shallow lakes and swamps. Here they wallow in the soft mud, feed upon the water lilies and aquatic grasses, and escape the torment of insects. The cool September days find them clothed in their choicest nuptial suits of glossy black and golden tan, with well grown horns; and the sexes again seek each other—the cow now with one or two calves by her side. The most terrific encounters ensue betwixt the males. The approach of two males in the still autumn night is heralded by such loud snorting bellows, and such crashing of branches by each male's horns, as to resemble cart loads of plank thrown violently upon the ground. This bellowing to unseen bellow, this crash of unknown violence swelling upon the night wind, is said to make the heart of the oldest hunter throb to his last pant. Usually, however, the slightest crackle, or the least odor or scent of the hunter, sends this timorous creature back in a retreat so noiseless as scarce to be credited from his loud advance. Towards the end of the rut, some few bulls become infuriated, attacking the cow, equally as the bull—attacking everything. David Eason informed me that, once after calling unsuccessfully a long time, he left his cover and without his gun crossed a little knoll that lay in the open before him. Almost immediately from the crashing in front, he knew that a bull was before him, and he had no time to reach cover or gun. Sinking into some alders he saw the infuriated beast betwixt two spruce pines, rearing on his hind legs to ten or twelve feet, and shredding every branch from either tree with his horns, as he descended. Again and again did he rear till his huge form was shrouded in a mist of pine leaves, recent branches, bark shreds and dust of the withered dead arms, always hanging on the boles of pines. Many years had passed, when he told me the tale, yet his description of the horrid bristling crest, glaring eyes, and steaming breath from hideous swollen nostrils, was too graphic for me to doubt the truth, or its effect upon him at the time.

Towards November the cold winds and early snows, teach them it is time to yard. So collecting in families of four to seven or eight, usually two or three cows with attendant calves and several bulls, they retreat to some valley betwixt hardwood knolls, for the winter. If the browse is plenty, and the cover good, they wander very little. The various maples, the poplar, ashes, dogwoods, moose-wood, and alders, are their principal food. Seeing one day in the forest some saplings shred away some twenty feet from the ground, I asked Sam Copeland, an expert in all kinds of wood-craft, if porcupines had done it? No, was the answer, "moose browsing." They ride down between their fore legs a young tree, and browse on the top, then allow it to spring up again. If, as I said before, the browse is plenty and they are undisturbed these yards become beaten down almost like a farm yard, and the early spring and melting snows finds them still in the same spot. But now-a-days this rarely happens. Few yards remain undisturbed by the hunters.

But this brings me to the description of their capture. They were formerly taken by snares set in the forest, but this mode is now prohibited by law. Another mode is by calling, that is, during the rut the hunter imitating the voice of the female, and calling the bull within shot. On a frosty evening or at dawn of a September day, with a half filled moon hanging just above the tops of the tall spruces, and giving light enough barely to a narrow horizon, with the cool down wind blowing in your face, is the most favorite time. On such an eve, or day dawn, a party will lie wrapped in their blankets, over their rifles, concealed by a rock or shrub, while an

Indian standing motionless will imitate the cry of a female deer by means of a birch bark trumpet. Presently a wandering bull answers it; faint and far away it floats upon the night wind; but each answer comes louder and louder. More plaintive and pleading are the Indian's wild guttural sobs. Presently he sinks into the ground, as crash after crash, and snort after snort, tells him of the near approach of the deluded bull; and a toss up of his hand gives the sign for the party to fire. Simultaneously their double-barrelled breach-loaders ring out, like platoon firing, as their eyes have long been straining at and their rifles covering a dim shadow in front. The huge shadow turns heavily and slowly fades into darkness, with stumbling crash of branch and limb, and then all know he is mortally hit.

"Find him to-morrow morning, this side little brook," says the Indian. Had he disappeared noiselessly, there would be the chance of his not being hit; but there is no looking now, the moon has gone down. Through the darkness and the night mist, they grope their way to camp, knock the smouldering brands together, light their pipes, and wrapt in their blankets soon defy the hoar frost that is painting their sleeping forms. No description can show the fascination of this sport. But to play the play aright, wood craft, ardour, self denial, endurance of cold and wet, and, above all, prompt and thorough obedience to your Indian hunter, are all so necessary, that there are but few players in this sylvan scene. Above all, it is unsportsmanlike; it is breaking the first law in every code for the preservation of game; it is disturbing the game in their breeding time. To have a close time for all birds, beasts and fishes, for re-production, is the first and fundamental law of all game legislation.

Yet we have time only to touch lightly here, and proceed to the next way of hunting, which is called still-hunting or creeping here in America, but stalking in England, and which calls forth in the hunter the highest qualities of his art. A white man needs a slight snow to track his quarry within shooting distance; but it is marvellous to see an Indian throw himself upon the ground, and just where your heedless foot has passed, spread apart the dead leaves, and show you the impression in the soft earth of a moose's foot. There it is plain enough now, in all its beauty: two sharp pricks for the toes, two little parallel mounds, moulded by the concave double hoof. Flat upon his face he is noiselessly worming himself around to find its direction; and he presently tells you a large bull has passed an hour ago,—he was going very slowly,—he is about a mile ahead, in a south by west course,—that the wind is right down upon him,—that you must make a long circuit and come upon him against the wind,—that you must put your pipe out, not even whisper, and follow him at a little distance, avoiding every broken branch,—and that he will give you signs by his hand!

Humbled by having such a page of forest lore taught you, from what, to your dull Saxon senses, was rotten bog and dead leaves, you follow your guide, now sliding betwixt the tree boles, with his right shoulder overhanging, his gun carried well forward, and his elastic moccasined foot avoiding every rotten branch. For an hour or two, he carries you through swamps, through barren, over hard-wood hills, and over wet meadows, until with a motion of his hand he tells you that the deer is now half a mile direct to windward, and he points his hand: you look in vain, till almost contemptuously he says, "them branches, move against wind," and then you see some branches rudely agitated by the unseen deer in browsing. Down on his face he goes again, worming himself like some hugh noiseless anaconda, dragging his gun after him; you clumsily follow him till you get within a hundred yards. He beckons you to him, and there you, lying upon your face, see within range a huge antler, tossing up and down, a great yellow ear flopping up, or a grey crest of coarse hair, over the thick alders. Your Indiam says, "now!" and you give him one barrel of your breech-loader. "Too high—long range gun, always go high!" he says, as a scud of hair and dry leaves, drifting to leeward, show you have missed; yet the deer is not much alarmed, he sees and smells nothing. Springing up he usually makes water, then goes off in a long trot. As his huge fore shoulder comes out, bang goes your Indian's muzzle loader, followed by your second barrel; with a frantic bound he breaks cover, and plunges into the forest. Your Indian has reloaded, and springing to the spot, whilst the smoke of the gun is still lazily floating around, he picks up the flakes of bloody hair, points out the blood spattered leaves, the broad trail and the long slides in the wet moss, of the already yielding limbs, and says in his quaint terse broken English, contrasting so favorably with what I have heard sportsmen call, "white fellows' gab," "got it bad, worse sort." As indeed the bull has this time,—right through the lungs cutting the great blood vessels, have both bullets gone. A half hour's search shows you your victim, sitting like a dog on his haunches, his mighty head all too heavy for his trembling limbs, his tongue thrust out, and bloody foam snorted from mouth and nostril, in convulsive throbs. This is indeed sport of the highest order—yielding indeed in personal danger to tiger hunting in the East; but in endurance, in self-denial, and restraint, in quickness of eye and promptness, and precision of hand, but, above all in wild luxuriance of northern scenery,—either magnificent hemlock or pine, sweet sylvan, lily carpeted lakelet,—whirling rapids caught by a beaver dam,—or vast, purple-berried barren—nobody's home but the owls or the foxes—is second only to the chamois hunting on the Alps.

There is a third kind of hunting which we will briefly notice—following the deer on snow shoes. When the learned Lescarbot, in 1606, was at Annapolis, he tells us the Indians took him to see a moose pulled down by large dogs about two leagues in the forest. The Indians are gone, the Frenchmen have followed, yet the moose and the big dogs still remain to the Saxon conquerors. From that time this manner of chase has been handed down, and two hundred and fifty years afterwards, I have seen the big dogs pull down a moose on this very ground. From the last week in February to the middle of March, the snows from being heated by the warm suns, and frozen at night, acquire a crust, hard enough to bear dogs, and men on snow shoes, but which the moose breaks through. Whenever this takes place, a party of settlers form a hunting party. Four or five men with eight or ten dogs, (a half Newfoundland crossed by a bull dog is the best, combining the broad soft foot of the one with the courage of the other) leave their homes by the dawn of a bright March morning. Each man carries his gun, an axe, and eight or ten pounds of meat and hard bread, slung on his back in a bag, with a tin pint mug hanging to it. Perhaps a two hours walk through snow-paths, brings them to where they suspect a moose yard. Each man now laces on his snow-shoes, before dangling at his back, and the ardour of the dogs can scarce be restrained. Some scent the snow, others sitting on their haunches with their noses high in the air, snuff every suspected breeze, others again standing completely upright upon their hind legs. An old bitch will now give a cry, and start straight as an arrow through the underbrush, and disappear. She is followed by the whole, and soon the forest rings merrily with their tongues, as they have struck the track, where some moose perhaps an hour ago has passed, leaving deep holes in the snow. Every one pushes to the front. The forest is one vast white sheet spread before you, losing itself among the tree boles. If the dogs are good, or the moose a young cow, they may rush upon her, and hold at bay, till the hunters come up. But if she ever gets the start of them, they never reach her again, till twenty or thirty miles chase has brought her strength to the last gasp. But this one is a strong and cunning quarry. He has got well away from the dogs, their cries sound fainter in the distance; and the hunters recovering from their spurt, settle themselves to a steady space. There is twenty or more miles before them; night will fall upon their tracks. The dogs now fall in by twos and threes, and follow in the back tracks. The cunning deer keeps now in the soft green woods and fir plantations; the crust is less sharp to his legs. But the going is heavy for the men. Two hours, may be, he baffles them before they push him out of his cover. He tries a swamp now and the whole party comes to a stand. His tracks are lost beside a running brook. He has bounded from the banks into the stream, leaving not a sign. The party breaks into pairs, some hunting up stream, some down stream, till a loud shout soon calls all to where he has sprung from the bed of the stream upon the banks again. The white snow is soiled by the muddy water dripping from his flanks, and the hunters view with pleasure the blood stains from his bleeding hoofs. Yet he is off with renewed vigour, and leads over hard wood hills, down precipitous banks, and coming to one of those forest lakes stretching, reach after reach, with many a jutting point, for a mile or two, takes the ice. Off goes every snow-shoe, and with moccasined foot, they follow his deep scratches, and a blood red line reaching from beneath their feet, till it loses itself in the far distance. The pursued and the pursuers rejoice on the hard surface, but it comes to an end, and he is again in the soft wood. Many an anxious look is flung at the fading light, the long shadows of the trees, and the red west, and again at his bleeding tracks, smoking dung, great scoups goudged out of the snow by his teeth, and deepening groove made by his tired hock in the snow. They are pressing him hard, but the low wintry sun is leaving them. As they are passing a running brook where water can be had, the captain of the hunt says, "we must camp, and take him to-morrow." A fit spot is chosen,—a square perhaps twelve feet by five, is marked out on the snow,—the snow is shoveld out by snow-shoes till the ground is reached. This is speedily roofed over by uprights stuck in the snow,—cross pieces, and poles reaching from the ground to the cross pieces, and thatched by spruce branches. The back and two sides are covered in, but before the front roars already an immense fire. You line your snow hole with branches, and creep into it, with the fire blazing about three feet above you. In two or three hours it has melted the snow beneath it, and settled down to your level. Had you not dug out your snow hole you would have found yourself on the top of the snow, and before midnight the fire in a deep pit below you. These hardy men now boil their tea in their tin cups, fry a little pork on the end of a ramrod, and, with hard bread, make their supper, and without an extra covering sleep before their camp fire. I have myself passed the night with the bread in my knapsack on which I pillowed my head frozen like a stone, my tin cup frozen to the brim, and my green hide moccasin buried in the branches beneath me, to keep them from the frost. A half mile beyond, as the noise of men and dogs fades in his ear, has the tired deer flung his red and stiffened limbs to rest on the snow. By day light the camp is broken up, the dogs are laid on, and you pass his soiled and bloody bivouac; but his great strength is failing him — his endurance done. Men and dogs push with irresistible ardour to the front, as every sign portrays his nearness, his dung still smoking, branches vibrating where he passed, and a breast high scent infuriating the dogs. The foremost hunter, (I have seen him bare headed and stripped to his shirt sleeves, with the thermometer at zero,) soon wipes the sweat from his brow, to take sure aim at the huge beast floundering before him, assailed on nose and flank, and ear, and hock by dogs. It is in vain that he makes such enormous bounds, or that he has killed one of his tormentors, cutting his ribs from his spine by a blow of his sharp hoof. Others rush in, aud the snow that ten minutes before lay in its virgin purity is for many a yard tramped down by the great deer in his agony, torn up by the rioting dogs in their fury, reddened with blood, and matted with coarse gray hairs. Your victim lies a motionless heap in the centre, perhaps his thirtieth mile stone. This is a faithful chronicle of a successful hunt, and hard enough at that, but when to it are added all the unsuccessful ones, the storms endured, the cold, and especially the heavy rains, it must be confessed the sport is hard. Yet I have known men entirely fascinated with it. William Dargie, now a magistrate, grown old, and cruelly cut up by rheumatism, and Sam Copland, who met a woodman's death, on the snow and alone, were the best captains of the hunt, I knew. This sport is now made illegal by the close season commencing the first of February. It would be entering into a subject foreign to this paper to discuss this matter.

We will turn, then, to the next subject—the identity of our Moose with the Elk of the ancients, and at present habiting Sweden, Norway, and some parts of Northern Russia. Our moose inhabits a belt of forest reaching from Nova Scotia in the east to beyond the Rocky Monntains in the west, and from about 44 N. Latitude to 70 N. Latitude. Linnæus who described him first evidently considered him a variety of the Elk, leaving his specific difference doubtful. Sir John Richardson inclines to consider him distinct, and mentions the Elk as having a broader forehead. The Royal College of Surgeons determined that there was no anatomical difference between them. But lately Capt. Hardy, R. A., a member of this Institute, returning from Nova Scotia to England, with all his recollections of the Moose fresh, and also his measurements and drawings, compared them with two young Elks from Norway belonging to the Prince of Wales. In his opinion given in the "Field" newspaper they are identical, and there are no specific differences between them. In the absence of all osteological differences by the Royal College of Surgeons, we must admit them identical, as Capt Hardy's opportunities of investigation, and accuracy, as a naturalist, are second to none. (I may here be allowed to deplore the loss our Institute has met with in this accomplished gentleman returning home.) Granting them identical, we must return to the old specific of Linnæus, "*alces*," he being the first describer. Hamilton Smith has recently subdivided the genus "*cervus*," also Linnæus, into various sub genera, and given the name *alces* to that in which the Elk or Moose is placed. This has been allowed by all modern naturalists; and thus, notwithstanding the alliteration, by the rule lately adopted by all nations, we must call him *alce alces*, instead of *cervus alces* of Linnæus. Nomenclature and classification are subjects too profound for field naturalists to do more than follow those whose profound studies and enormous collections entitle them to be heard on the subject.

I have now, as far as one paper would admit, studied this great boreal Deer existing in our forests,—his appearance when young, and adult,—his habits, and his wide spread habitat in America, and his identity with the Elk of the ancients and Europe. I have sketched lightly the various forms of his chase and capture, and in all this shunned authors, and given my own personal experience. We have found him differing from all known forms by the shortness of the neck, and the length of his cannon bones. He has again resemblances to the equatorial forms of the Elephant in the short neck,—to the Giraffe in the length of leg,—and perhaps to the Tapir in the prehensile elongated upper lip: but no affinity to either of them. It is a form adapted to be always wading, and here again he reminds us of the stilts or long legged wading birds. In summer the shallow lakes and swamps are his abode. In winter his long cannon bones are thrust into the snow. In both places they serve him in seeking his food. An anatomical investigation easily shows how the great weight of his horns are so easily carried,* as well also that the bones of the vast head are not heavier than those of ordinary deer. The huge nostrils are cavernous and hollow,—and the pendulous lips with no boney base. This elongation of the cannon bones, both makes him straddling in his gait, and diminishes his speed when out of cover. The hind leg must outstep the fore, and hence it must go outside of it, or straddle. The very short cannon bone of the greyhound with the enormous fore arm, and the approximation to it caused by breeding in the race horse, the very opposite to the moose, show that their forms are the best adapted to fleetness. But on the other hand he strides over every obstacle, mounted upon his huge stilts. It is probable this boreal form so existed with many now extinct forms whose fossil bones are found in the post and upper tertiary deposits. American naturalists have found his fossil bones in the upper tertiary formations in Ohio; and as, so far, they have not been found in the old world, we may claim our Moose as the original type.

With the Caribou it is probable that he was one of the earliest fauna that arrived after the glacial period, and, as far as any existing causes show, he may be one of the last remaining. As in Canada and New Brunswick, he cannot fall back upon back forests. He is surrounded on all sides by cultivation or the sea; and in diminished numbers, he may possibly remain for ages on the shallow lakes, impassable swamps and barrens forming our interior. He can exist on a less range than the caribou; he is less intolerant of the sights and smells of civilization. Nothing but the encroachments of roads, of setlements and railroads, destroying his range, can extirpate him. Our bears trouble him not, nor have we wolves to band in packs to hunt him down; and notwithstanding the Game Protection Society, our settlers do not diminish his numbers. The work is too hard,—there are too few to risk the toil. Now, though coaches do daily run, and taverns fling out their signs

*The back of the head being usually carried in a line with the top of the shoulder, or withers, a strong tendon passes between them, thus throwing the weight of the head and horns upon the shoulders. Thus they are not supported by muscular contraction. Otherwise the animal would pass his whole life in adjusting the load, ever varying from nothing to fifty pounds thrown upon his neck.

where a few years ago I could scarcely push my horse,—though a railroad is coming from Yarmouth directly through the centre of the Province,—yet there are places so utterly sterile, so impassable by granite boulder and marshy swamp, as to defy any engineer; so barren as to tempt no one; and here he will make his last hold. He will remain unchanged; and other men, in other garbs, with other governments, will cover with their rifles his fawn colored ears, or branching antlers.

As the princes of Europe follow the urus at the present day in the Black Forest of Germany, so too may an indigenous line of native princes in those days to come, stalk their huge deer in the heart of Queen's or Shelburne.

As with the ruminantia the papers I have had the honor to read before you, on the mammals of Nova Scotia, end, I have thought it well to republish a list of the whole mammals.

I think this list will include all, with the exception of a shrew, or a mouse or two, yet to be added—I know of no other list except my own, and in using the term identified by myself, I only wish to add to it the interest of personal verification. I shall use the classification of Dr. Baird (Smithsonian Institute), with the synonyms of Sir John Richardson when procurable, thus using the best American and English authorities, being satisfied that whilst no one can be but charmed by the accuracy, exactness and minute description of the great English traveller, on the other hand they must equally acknowledge the exhaustive labor of the American naturalist, though they may differ from him in some of his conclusions.

Cheiroptera,—Bats.

Vespertilio subulatus, Say, Richardson,—Say's-bat.
Vespertilio cinereus, P. D. Beauvois, 1796, } Hoary Bat.
Vespertilio pruinosus, Richardson, }

Dr Allen, (Monograph American bats 1846,) puts this last species in the new genus "Lasiurus." It is very rare in the Province, whilst Say's bat is very common. Capt. Hardy gave me a bat whose interfemoral resembled "evotis" (Allen). I am unwilling, however, to make it this species.

Insectivora,—Shrews.

Sorex palustris, Richardson,—Marsh Shrew.
Sorex fosteri, Richardson,—Foster's Shrew.
Sorex platyrinus, Baird,—Eared Shrew.
Sorex thomsoni, Baird,—Thomson's Shrew
Sorex acadica ? Baird,—Nova Scotia Shrew.
Blarina talpoides, Gapper, Baird.
Blarina brevicauda, Say, Baird.
Blarina angusticeps, Baird.
Blarina cinerea, Backman, Baird.
Condylura cristata, Baird. } Star-nose Mole.
Condylura macroura, Richardson, }

Of these species Palustris would undoubtedly be placed in Baird's new genus, " Neosorex." I have put a mark of interrogation after " Acadia," as it is as yet undescribed, except by myself, and may turn out " Thomsoni," (see transactions, Nova Scotian Institute, 1864). These long-tailed Shrews are by no means uncommon. Following other authorities, I have distinguished " Talpoides " from " Brevicauda," and though there is undoubtedly great divergence in colonr and size of our " Blarina," yet all the typical marks remain the same. I have been fortunate in obtaining a specimen, I believe the second one known of the very rare " Angusticeps." Of Moles I have never met with one in the Province. They are represented by the one species of Condylura which is common. These Shrews brave the coldest winter—their minute tracks are seen on snow, at least four feet above the frozen ground, beneath which are their holes; through this snow they must penetrate to come to the surface. They are seen swimming in ice-mantled streams. Hunters cutting an ice hole in a frozen stream for a drink have had them darting from below almost into their mouths, and as suddenly plunging in again.

Carnivora,—Flesh eaters.

Lynx rufus, Guldensteadt, Baird,—Wild Cat.
Lynx canadensis, Geoff, Baird, } Loupcervier.
Felis canadensis, Richardson, }
Canis occidentalis, Richardson,—Wolf.
Vulpes fulvus, Richardson,—American Fox.
Mustela pennanti, Erxleben,—*Canadensis*, Richardson,—Fisher.
Mustela americana, Turton, Baird, — *Martes*, Richardson,—Marten.

Putorius cocognanii, Bonaparte, Baird,—Small Weasel,
Putorius richardsonii, Bonaparte, Baird,—*Erminea*, Richardson.
Putorius noveboracencis, Dekay, Baird,—White Weasel.
Putorius vison, Richardson, Baird,—Mink.
Putorius nigrescens, Audubon, Baird,—little Mink.
Lutra canadensis, Sabine, Richardson,—Otter.
Mephitis mephitica, Shaw, 1792, Baird,—*Americana*, Richardson,—Skunk.
Procyon lotor, Richardson, Baird,—Raccoon.
Ursus americanus, Pallas, Richardson, Baird,—Bear.

Of these fifteen species, we find the Loupcervier, a truly boreal lynx, with its congener the wild cat, a more southern form, and no doubt of much later appearance ; the wolf in his white or grey variety, endeavouring in vain to re-habit the Province. During the last sixty or seventy years they have constantly appeared, singly and in pairs, at each extremity of the Province, and then have been unheard of for years. The fox, very numerous, of great beauty and lustre of fur, but subject to nigritism and varying according to its intensity, from the red, to the cross, the silver grey, and black. The magnificent tree weasel, the fisher, its congener, the American marten, only lately separated from the pine marten of Europe, and still more recently classed as a variety of the Russian sable, (M. zabellina.) The ermine weasels, (though the common short tailed weasel common in New England is here unknown), the American otter, now separated from the European species, the skunk and raccoon both later in their arrival (almost during our own times), and of a southern form, and the truly boreal form of the American black bear, perhaps our earliest carnivora, and destined to be the latest. His vegetable diet of berries and roots, and his long winter sleep mark him the inhabitant of sterile and frozen lands.

Rodentia.

Sciurus hudsonius, Pallas, Richardson,—Red Squirrel.
Pteromys hudsonius, Gmelin, Baird,—*Sabrinus*, Richardson,—Flying Squirrel.
Tamias striatus, Linn. Baird,—*Systeri*, Richardson,—Ground Squirrel.
Arctomys monax, Linn., Baird, Richardson,—Wood Chuck.
Castor canadensis, Kuhl, Baird, Richardson,—American Beaver.
Jaculus hudsonius Zimm., Baird,—*M. labradorius*, Richardson,—Jumping Mouse.

Mus decumanus, Pallas,—Brown Rat.
Mus musculus, Linn.,—Common Mouse.
Mus rattus, Linn.,—Black Rat.
Hesperomys leucopus, Rafinesque, Baird,—White-footed Mouse.
Hesperomys myoides, Baird,—Hamster Mouse.
Arvicola gapperi, Vigors, Baird,—Gapper's Mouse.
Arvicola riparia, Ord, Baird,—Meadow Mouse.
Fiber zibethicus, Baird, Richardson,—Musk Rat.
Erethizon dorsatus, Linn., Baird,—*H. pilosa*, Richardson,—Porcupine.
Lepus americanus, Erxleben, Baird, Richardson,—Hare.

Of the sixteen species here enumerated we find a tree squirrel, a flying squirrel, and a ground squirrel, all northern forms, two partially hybernating, and laying up winter stores, the other totally disappearing beneath the ground in winter. We find also a marmot peculiarly northern in his hybernation and gross fat. I cannot but think that Pruinosus of Richardson will be found only a northern variety of Monax. Specimens are found here so very hoary, with the hair on the shoulders so much longer than on rump. I have also seen them flattening themselves on the ground, as Audubon describes Pruinosus as doing at the Zoological Gardens, London. To the historical beaver succeeds the sub-family of mice. Of the three introduced species, the common mouse has penetrated everywhere, the brown rat chiefly on the sea-board, and the black rat very rare ; I suspect some, if not all, come to us from the West Indies Our indigenous species so far identified are the very beautiful jumping mouse—the white-footed mouse with his closely allied congener, the hamster mouse, differing only in having a longer tail, and cheek pouches,—and two voles. I think another vole may be added to our list. The jumping mouse and the voles all hybernate, the others but partially, laying up stores of beech mast and grain in hollow trees, and often found lively at mid winter. The musk-rat, porcupine, and varying hare, all northern forms, close the list of our Rodents.

Ruminantia.

Cervus alces, Linn., Richardson, *Alces, americanus*, Jardine, Baird, *Alces muswa*, Richardson,	The Moose.
Rangifer caribou, Ham, Smith, Baird, *Cervus tarandus sylvestris*, Richardson.	Caribou, Reindeer.

Our list ends with the truly noble, antlered and boreal forms of our two species of deer. Of these the caribou supposed identical with the reindeer of Europe, though not proven, but differing from the barren ground caribou of the Arctic circle, is becoming extinct the most rapidly. Though following Jardine and Richardson I have given the specific "Americana" and "Muswa" to the moose, there can no longer be a doubt of its complete identity with the Elk of Sweden and Norway.* Captain Hardy, R. A., a member of our Institute, (than whom there can be no more competent authority,) fresh from studying the moose in the Nova Scotia forest, with all his recollections, drawings, and measurements, has compared him with two young elks from Norway, the property of the Prince of Wales, and pronounces them identical. (See "Land and Water," Aug. 15, 1868, with illustrations.) In Captain Hardy's sketch the forehead appears broader than in the moose. This is the point insisted upon by Richardson as the difference between the two skulls.

In not adding Meriones (Jaculus) acadica, (Edn. New Phil. Journal, 1856,) to the list, I owe it to so learned a naturalist as Dawson to explain that the specimens upon which he founded his new species, and which he obtained from Mr. Winton, Halifax, were prepared for myself, and described as the young of J. hudsonius, (Zimm.,) in a lecture before the Mechanics' Institute, Halifax, about 1850, and that though being unwilling to differ from him, and still more unwilling to lose a mammal from our Province, I still retain my opinion. Of animals not identified by myself, but sometimes to be found in the Province, I think the Virginian deer (Cervus virginianus) will be found in the Cobequid hills, as I personally know they have been taken at Dorchester, N. B., near the boundary line. There is a tradition of a wolverene (Gulo luscus) having been taken in the same wild country. A large black squirrel skin (Sciurus carolinensis) with nigritism, was given me from Cumberland. Of the Pinnipedia or seals and Cetæ or whales, I have identified none. From the labours of Dr. Gill we unexpectedly learn that our common seal is identical with the European, (P. vitulina,) and the harp (P. groenlandica,) and the grey seal (H. griseus, Neilson,) are all common to each continent. This identity running through the fish, amphibious mammals, the sea birds, and larger land mammals, seems a good proof of our common glacial period and gradual emergence. Of extinct species, during historic time, we may enumerate the walrus, with its

*Since this was in press Sclayter in list of vertebrates, Zoological Garden, 1872, gives alces, machlis, considering them identical.

companion of another class, the great auk. Of prehistoric remains, I only know the solitary gigantic thigh bones of a huge mammal found at Cape Breton. Of those whose early extinction, perhaps in our own times we may reasonably expect, we may enumerate the fisher, (M. pennanti), now very rare, and next the marten, (M. americana). Both these great tree weasels require dense cover. The beaver, twenty-five years ago nearly extinct, is rapidly recruiting. The less value of his skin since velvet hats have been patented is not sufficient to account for his re-appearance. The few or no Indians now trapping in our forests is perhaps another cause. With these exceptions, allowing the same influence to exist, I see no reason why we should not retain our present fauna for centuries, including the large ruminants. Our last arrival was the wolf, endeavouring in vain to rehabit his old domains, to whom the skunk and the raccoon alone give precedence. All these coming in to us from the wild region of the Cobequid hills. Of introduced species, with the exception of the mice, we have only the horse (E. caballus), and the rabbit, (Lepus cuniculus). Both these species have been allowed to assume the feral state on Sable Island, a desert island about ninety miles south-east of Nova Scotia, in the Atlantic Ocean. Whilst the rabbits in fifty years have returned to one common silver-grey tint with white collars, it is curious to remark how the horse in one hundred and fifty years, the produce no doubt of the New England stock, has returned to the habits and form of the primal stock, or wild horse of antiquity, and reproduced all varieties of color, not only the bay, black and chestnut, but the rarer colors of piebald, duns, isabellas, blue duns, and duns with striped legs and black lists down the back.

Parallel

ART. V. ZONES OF LINES OF ELEVATION IN THE EARTH'S CRUST. BY ANGUS ROSS, ESQ.

(*Read January* 8, 1872.)

ELEVEN years ago I was living on Digby Neck, a prolongation of the North Mountain Range, and a district which with its great variety of quartz, and other minerals, and the obviously unsedimentary character of the trap and basaltic rocks of which it chiefly consists, is well fitted to stimulate curiosity and awaken thought as to its origin. I remarked that it had a corresponding and parallel synclinal or line of depression, along its more southerly side, extending its whole length from St. Mary's Bay to the Basin of Minas (inclusive); and that the general direction of the Atlantic coast line of the Province was approximately parallel to it; as also the Fundy coast of New Brunswick, and the Atlantic coast line of the United States, from Eastport to Baltimore, and from Cape Hatteras to Florida. Further examination showed that lines of elevation (and depression) parallel to these, formed the leading features of the Continent east of the Ohio. Of these the most remarkable are the valley of the St. Lawrence, and the Appalachian Mountain ranges. (See plate I. fig. 1.) Travelling afterwards in Newfoundland, I found that the chief lines of elevation in the Peninsula of Avalon had the same general direction. At Sandy Cove, on Digby Neck, I remarked that the ravine like break in the trap ridge, evidently at one time a sea channel, was not at right angles with the ridge, but running north and south—the ridge itself running nearly N. E. and S. W. I remembered that Trout Cove (now Centreville, five miles further up the Neck) was similar in this respect, and I found that the same was true of Grand and Petite Passages. I found, too, that most of the River basins of Shelburne and Yarmouth counties, as well as some of the river and lake basins in Hants, had the same direction, thus indicating another system of synclinals and anticlinals. The basin of Hudson River and Lake Champlain and the basin of the Connecticut, seemed correlated with this system. The trap ridge gave evidence of another system of lines of elevation, to the extent at least that produced an immense number of parallel fractures in the trap, having the direction (approximately) of east and west, and filled by quartz, sometimes nearly pure, sometimes in the form of jasper; sometimes containing pockets having beautiful crystals of variously colored quartz, and sometimes containing metallic minerals. This system seemed correlated to the Cobequid Range, and the line of depression which forms the great central basin of the province, commencing at Minas basin, and extending to St. George's Bay.

Since gold has been discovered in this province, attention has been prominently called to the fact that an important system of lines of elevation in the gold bearing rocks, have the same general direction—approximately east and west—and that the auriferous quartz veins uniformly have this direction. Now, it is evident to one even slightly acquainted with the Geology of the regions referred to, that not only the fractures but the trap itself was formed long after the east and west lines of elevation in the Cobequid and auriferous rocks had reached nearly their present position.

The only other system of parallel lines of elevation (and depression) in Nova Scotia, which now demands our attention, is well illustrated by a basin with which all here are necessarily well acquainted. I refer to our own Harbour and Bedford basin, and, further on in the same line, the Avon River basin. An important line parallel to this is the Strait of Canso. For further illustrations of this system I may point to most of the river and lake basins between Shelburne and Canso.

Having thus briefly indicated the chief systems of lines of elevation in our own Province and vicinity, I will proceed to discuss the general subject to which they introduced me, viz. the great zones of parallel lines of elevation in the earth's crust.

More than two-thirds of the crust of the earth is covered by the waters of the ocean. The more recent formations cover most of the remainder. Again the later formations were necessarily formed of the detritus of the older, so that these, where exposed to observation, must have suffered immense denudation, as is also shown by their metamorphic character, as they could only have become metamorphic when at a great depth below the surface. These circumstances tend greatly to obscure the lines of elevation in the older rocks. But obscurity yields to investigation. The higher summits of lines of elevation protrude themselves above the level of the sea, and afford no uncertain indication of their course beneath its waters. The more primitive formations are similarly found protruding through the later formations, or these last have been removed by denudation, exposing the former to view. Nor are we always left to infer the lines of elevation of the older rocks, from those portions of them which are exposed to view, since as we have already seen they impress their lines of elevation, to some extent upon the superincumbent later formations.

By an attentive study of the lines of elevation in the earth's crust, in so far as I had the means of information, I find that all the more important of them group themselves into seven great zones of parallel lines of elevation; the axial line of each zone being approximately a great circle of the earth, and characterized by lines of volcanoes. The apparent development of these zones is much affected by the fact that the northern hemisphere has the surface of its solid crust considerably more elevated than is that of the southern hemisphere. At the 45th degree of latitude respectively the difference by a rough estimate is nearly two miles. But if, for the sake of illustration, we imagine the north pole of the earth in Iceland, and compare the elevation of the resulting northern and southern hemispheres at the thirtieth degree of latitude respectively, the average elevation would then be found to be more than two miles greater in the northern than in the southern. Hence result the following laws:—

1st.—That it is the half north of the equator of each zone that is chiefly exposed to our observation.

2nd.—That of those zones whose axial lines do not pass near the poles, it is on the northerly side of the northern half of the axial line that the chief *visible* development occurs.

In each zone the proximity and elevation of the anticlinals diminish gradually from the axial line outwards; and if zone No. 1 be considered the most recent, and the others as successively less recent in the order in which I have named them, and comparing similar parts of any two zones, the height of the anticlinals is greater, the dip less, and the distance between their axes greater in the more recent. In a transverse section of zone No. 1 or of any subzone of any of the other zones, each plateau rises above the preceding in regular gradation from the coast line (or other boundary of the zone or subzone) until the greatest elevation is reached; and the same is true of the mountain ridges separating the plateaus. By substituting *subzones* for "anticlinals" in the above, the relations of those to each other will be defined.

Zone No. 1, or the Rocky Mountain system, has its axial line in the volcanic belt extending from the Middle Andes, inclusive, across Central America, along the Rocky Mountains, Alaska, the Aleutian Island, Kamtschatka, the Kurile Islands, Japan Islands, Loo Choo Islands, Philipine Islands, Palawan, and Borneo. The Islands of Amsterdam and St. Paul, the Kerguelen Islands, the South Sandwich Island and South Georgia, seem to indicate the completion of the more southerly part of the (approximately) great circle. A belt extending ten degrees on each side of this great circle, includes two-thirds of the volcanoes of the earth.

On the northerly side of the more northerly portion of this axial line, there is by far the greatest and most unbroken elevated zone of the earth's crust, commencing at the plateau of Bolivia, which has a mean elevation of two and one half miles above the sea-level, it extends to Thibet, which has a mean elevation equal to that of Bolivia. The higher plateaus in each of these immense and nearly antipodal table lands, as also in the intervening table lands of Equador, reach an elevation of three miles; and the higher mountain ranges adjacent to them, reach an elevation of from five to six miles above the sea-level. This zone of table lands contains all the plateaus on the earth that reach an elevation of two miles; and all the mountains of the earth that reach an elevation of four miles are found immediately adjacent to these plateaus.

On the northerly side of the zone of table lands, is found a zone of plains—by far the greatest and most unbroken of the earth—extending from the mouth of the LaPlata to the Caspian Sea, and at an average elevation of about one-tenth of a mile above the sea-level. Their average breadth may be roughly estimated at 1000 miles, and that of the table lands at 1500.

Commencing at the N. W. extremity of the plateau of Thibet, a zone of table lands extends to the Cape of Good Hope—a distance equal to one quarter of the circumference of the earth. It seems primarily to have constituted part of zone No. 7, which I have not yet described, but to owe its present elevation to its connection with zone No. 1, to which it is here approximately parallel on the northerly side of its axial line. It has its great plain, the Sahara, on its northerly side. Taken in connection with the other zone of the table lands to which I have referred, we find an elevated zone extending three quarters of a circumference of the earth, over which one may travel (from Cape Horn to the Cape of Good Hope) at an average elevation of one mile above the sea-level, though no other plateau on the earth *reaches* an elevation of one mile.

Zone No. 2, the Appalachian, has its axial line in the volcanic line apparent along the Northern Andes, the Lesser Antilles, Sicily and vicinity, the volcanic Greek Islands, the Dead Sea region, Pondicherry, and completing the more *northerly* half of the great circle—the highly volcanic belt extending through the entire length of Sumatra. In the remaining part of the (approximately) great circle, we find the volcanic belt of New Zealand and the volcanic Islands of Chatham and Easter. Its apparent development is chiefly on the northerly side of the more northerly half of its axial line, embracing the eastern half of North America, and the South-west of Europe and Asia. Its highest plateaus reach an elevation of a little more than half a mile in North America and Europe, while in South America and Asia they owe their great elevation chiefly to zone No. 1.

In North America the part of this zone above the level of the sea consists of two well marked subzones, divided by the great line of depression extending from the Strait of Bellisle to the Gulf of Mexico. Of these the more northerly is the more extensive and unbroken; the more southerly having its strata more plicated (see Plate I. Fig. 2), and consisting largely of islands and peninsulas. Similar remarks would characterize the developments of this zone in Europe and Asia; the more southerly subzone consisting chiefly of the ~~seven~~ six great peninsulas, Spain and Portugal, Italy, Greece, Asia Minor, Hindostan, Farther India, and also many islands;—and the more northerly, continental in character, and having for its chief lines of elevation, mountain ranges, such as the Carpathian, the Caucasus and part of the Himalaya.

Zone No. 3, or the Parimean has its axial line in that very remarkable line of fracture extending across Mexico in a nearly east and west direction, a little south of the city of Mexico, and in which many of the active volcanoes have appeared, for the first time, in the present century, although along the old line of fracture. Following this line of elevation along the Greater Antilles, we reach the volcanic Lesser Antilles. Further on, near the coast of Africa, we reach the volcanic Cape de Verde Islands. Crossing the unknown interior we reach the volcanic district at the mouth of the Red Sea. Still onwards and completing a semi-circumference of the earth, we reach in Java the most active volcanic region known. This belt extends nearly east and west from Java to New Britain (inclusive), or an extent of three thousand miles. This axial line seems to be about five degrees *north* of the great circle to which it is (approximately) parallel. In America the apparent development of this zone consists of four subzones: the West Indian, the Venezuelan, the Parimean Proper, and the Bolivian, which last constitutes the watershed between the basins of the Amazon and the Rio de la Plata. In Africa but two subzones are entirely apparent, one on each side of the axial line. On the northern side are the various parallel ranges of the Atlas Mountain region, and on the south, mountain ranges extending east and west, so far as the country has been explored, from Cape Verde to Cape Guardafui. In Asia the apparent development of this zone is great in consequence of the elevation produced by its intersection with zones Nos. 1 and 2. The Thian Chan, part of the Himalaya, and many other mountain ranges, seem immediately connected with this zone. In Australasia there are three subzones plainly apparent; Java and the Flores Islands, &c., on the axial line of the zone, with the Eastern Archipelago on the north, and Australia on the south.

Zone No. 4, or the Scandinavian, has its axial line in a volcanic belt extending through the Azores, Iceland and Jan Meyen. Spitzbergen, not, however, known to be volcanic, is in the same line of elevation. Beyond this the Polar region is unexplored. In the same line in Eastern Siberia are the Aldan Mountain ranges, extending from the Arctic Ocean to the Sea of Okotsk. A line of islands in that sea, and the long island Saghalien, carry this line of elevation to the Japan Islands, which are highly volcanic, as are also the Marianne and other island groups which continue it to New Guinea (also volcanic), across which it is continued in a mountain range to Torres Strait. Across Torres Strait this line of elevation is apparent in a volcanic island range. From Cape York the Australian Alps extend to the southern extremity of this insular continent. It is continued in an island range across Bass Strait and in mountain range across the Island Tasmania; thus completing (from the Azores) a semi-circumference of the earth. The same line of elevation is again apparent in the highly volcanic range of South Victoria. Passing over the unexplored South Polar Region we find Graham Land volcanic. The Falkland Islands and the coast mountain ranges of Brazil are in the same line.

Scandinavia and the British Islands are examples of the development of this zone on one side of the axial line, and, as they are well known, illustrate well the *law* that the side of a zone or subzone next to the axial line, shows the most plication—the boldest and greatest anticlinals. Greenland—comparatively unexplored—represents its development on the other side of the axial line. Brazil is the only other part of this zone which is well known, and it also illustrates the law to which I have referred.

The Scandinavian zone is the region of "fiords," which characterize it alike in every part of the circumference of the earth. It is also characterized by a prodigious development of trachytic rocks, which, often being basaltic, form spires, and pyramids, and caves (Fingal's cave for example). Indeed the "family likeness" that regions of the same zone present, however widely apart, is very remarkable. Especially is this apparent in the three zones with which we are best acquainted, viz: Nos. 1, 2, 4. It may confidently be said that any one acquainted with their characteristic features, would have little difficulty in recognizing each by the general features of the face of the country, even without observing the direction of the strike—that is of the lines of elevation.

Zone No. 5, or the New Zealand zone, seems to have its axial line parallel to the chief lines of elevation of the New Zealand Islands, passing through Tasmania, the Fiji Islands, &c., through Hawaii in the Sandwich Islands, across North America from Cape Mendocino to Cape Race. From Cape Race it is continued in a chain of banks and volcanic Islands extending to Cape Juby. From Cape Juby it would pass through the unexplored regions of

Africa to Cape Corrientes, and thence through the Kerguelen Islands to Tasmania. The New Zealand sub zone apparent from Macquarie Island to the Friendly Islands (inclusive)—a distance of about 2500 miles—and highly volcanic, is perhaps the most renarkable.

Zone No. 6, the Sardinian, seems to have its axial line in the volcanic belt of which Etna, Stromboli and Vesuvius, are the principal centres of apparent activity. The Hawaiian Archipelago, the Society Islands, and South Victoria, are other volcanic regions through which this line would pass. In Europe, on one side of the axial line, the chief line of elevation apparent in the islands of Sardinia and Corsica, and the Peninsula of Denmark, is most conspicuous. A series of parallel lines of elevation in Britain—best known in the north of England—is also parallel to this axial line. On the other side of the axial line the most remarkable development is in the parallel mountain ranges which extend from the Red Sea to the Black Sea, and of which the basin of the Jordan forms one of the synclinals. The Oural mountains also seem to belong to this zone.

Zone No. 7, the Hawaiian, has its axial line passing through the very remarkable volcanic region of that Archipelago, (see Plate 2), through Yesso (in Japan) across Asia; through Arabia and Africa (near the coast) to Cape of Good Hope, and thence through the islands of South Georgia, Tierra del Fuego, and Easter to the Hawaiian Islands. The Island of Madagascar and other islands in the same range show the existence of a subzone, of which the apparent length is about 2000 miles. On the other side of the axial line and parallel to it are ranges of elevation apparent for 9000 miles, from the Cape of Good Hope to the Sea of Okotsk.

It is obvious that the axial lines of the several zones (being approximately great circles of the earth) will each intersect every other twice, and that the two intersections of any two axial lines will be (approximately) antipodal to each other. These intersections are, as might be anticipated, specially remarkable for volcanic activity, and where the intersections of more than two axial lines occur in the same vicinity, as might be anticipated, also the

Plate No 1.

Fig. No 1.

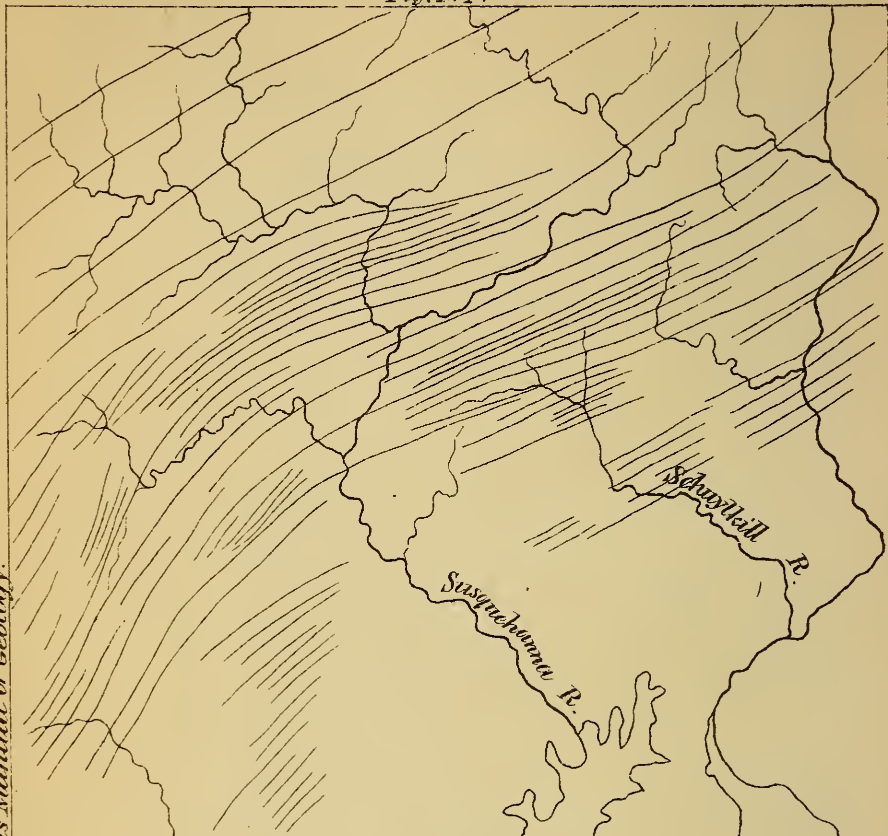
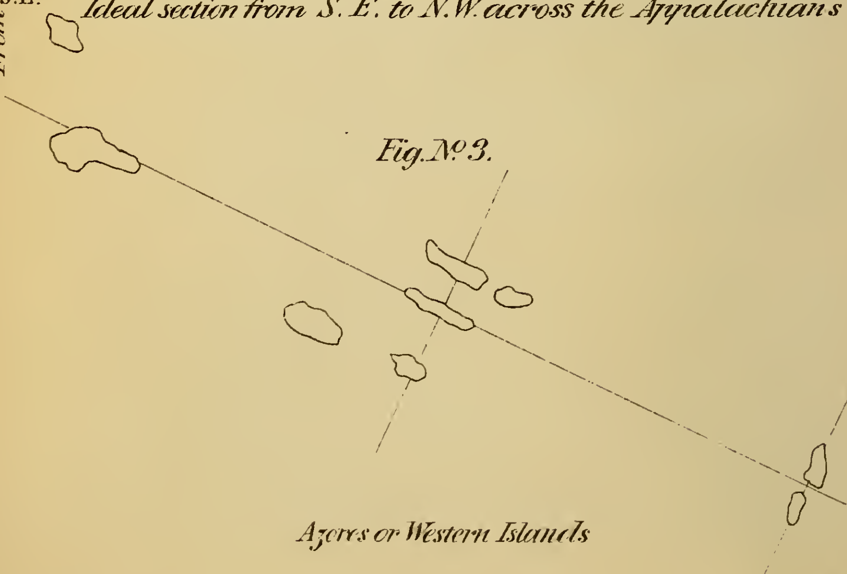


Fig No 2

S.E. Ideal section from S.E. to N.W. across the Appalachians N.W.

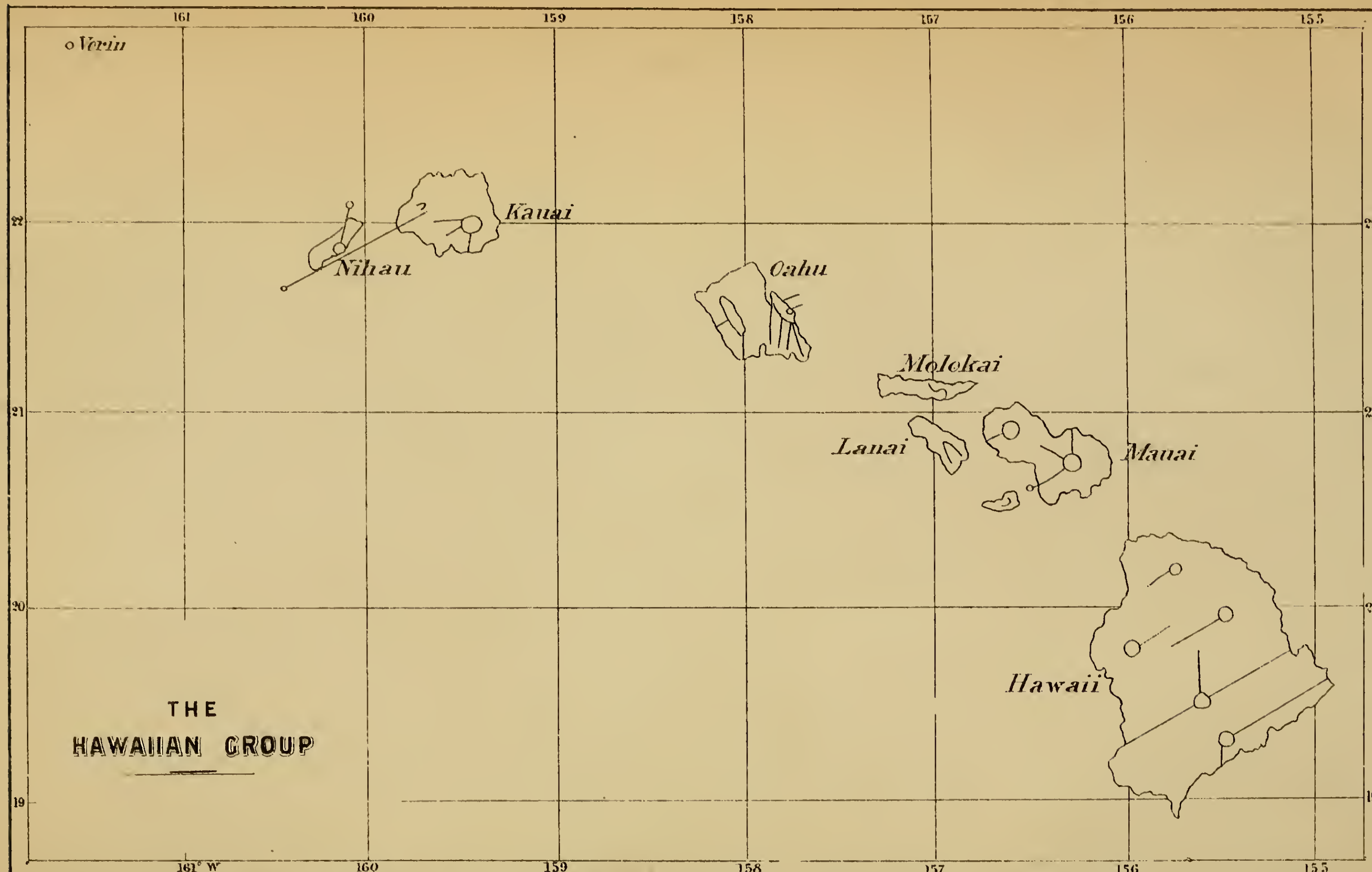
Fig. No 3.



Azores or Western Islands

From Dana's Manual of Geology.

Plate 1. No 2.



Wm T. Brigham on Hawaiian Volcanoes. (From Bos. Journal of N. Hist. Vol. I.)

St John & Halifax lith Co

volcanic phenomena are still more remarkable, and when these intersecting axial lines are those of the latest (and greatest) zones, the result is the most extensive and intense display of volcanic activity which exists on the earth. Thus the intersections of the axial lines of zones Nos. 1, 2, and 3 produce, in the East Indian Archipelago, the most volcanic region of the earth, and their antipodal intersections produce in Mexico, Central America, the Northern Andes, and the lesser West India Islands, the only other volcanic region at all approximating to it in extent and activity. The intersection of zones Nos. 2, 4, and 5, gives the volcanic regions of the Azores and Canary Islands. (See Plate I, Fig. 3.) Their antipodal intersection in Tasmania though indicating great volcanic activity formerly, is not now actively volcanic; but the intersection of the axial line of zone No. 2, with the great New Zealand subzone of No. 5, is marked by a high degree of volcanic activity. The intersection, apparently at one point, of zones Nos. 5, 6, 7, produces the exceedingly active volcanic group of the Hawaiian or Sandwich Islands. (See Plate 2.) Their antipodal intersection is in the unexplored interior of South Africa.

Where the axial lines of two zones intersect each other the volcanoes are found along the axial line of the older; thus where the axial line of zone No. 1 intersects that of zone No. 3, we find in Mexico a line of active volcanoes across the country in the line of No. 3, and in Java the result is similar. At the intersections of the axial lines of zone No. 1 with that of zone No. 2 we find the volcanic lines of the Northern Andes, and Sumatra in the axial line of zone No. 2.

Where three axial lines intersect each other at, or near, the same point, the volcanoes are found along the axial line of the oldest zone, though the systems of parallel lines of fracture of the other zones are very apparent; thus in the Hawaiian Islands (see plate No. 2) a line extending along the northern volcanoes of Hawaii to the northern volcano of Ohau, represents the direction of the axial line of the oldest zone—zone No. 7; while the other systems of parallel lines marked on the map represent the lines of fracture—that is the directions of the lines of elevation of zones Nos. 5 and 6. Fig. 3, Plate No. 1 represents the direction of the lines of elevation of zones Nos. 4 and 5 with accuracy, and as I had not seen it until I had become convinced from observations of other parts of these zones that they must intersect each other at the Azores, in the precise directions which they are there represented as having, I was pleased to find that figure in Dana's Manual of Geology, made without any thought of the zones of parallel lines of elevation, but simply by observing the facts of the case, thus well illustrating the correctness of the conclusions to which I had come by induction.

The axial line of a subzone sometimes becomes volcanic where intersected by the axial line of a later zone; thus where the axial line of zone No. 1 intersects the sub-zones of zone No. 4 on the east of Asia, we find on one side of the axial line of zone No. 4 the volcanic Peninsula of Kamtschatka, and on the other side the volcanic Peninsula of Corea, and the more distant subzone of which the axial line passes through the volcanic islands, Formosa and Luzon. Where the axial line of zone No. 2 intersects the New Zealand subzone of zone No. 5, that subzone is also volcanic.

The forms of the craters of volcanoes seem to be largely determined by the lines of fracture, and these are determined by the lines of elevation; hence it follows that the forms of the craters of the volcanoes of any group have a striking similarity to each other, and resemble those of other groups, in proportion as the producing causes, the intersections of axial (and related) lines, are similar. The longer axis of a crater is found, not in the line of the volcanoes, that is the older of the intersecting axial lines, but in the later axial line (or parallel to it). Thus the Latin line of volcanoes (Etna, Stromboli, Vesuvius, &c.) is in the axial line of zone No. 6, the Sardinian, and has the major axis of its volcanoes parallel to the axial line of zone No. 2, as these axial lines intersect each other here. Where the axial lines of three zones intersect each other as at the Hawaiian Islands, the result is more complicated, but governed by the same law. Thus Kilauea in Hawaii (the more important of the two active volcanoes in that group) has its major axis in the line of zone No. 5—the most recent of the three intersecting zones,—while the extinct volcanoes of this group have their major axes in the lines of zone No. 6 (an older zone), and the volcanoes themselves are in the line of zone No. 7,—the oldest of the intersecting zones.

There is a remarkable coincidence between the prevailing zone of parallel lines of elevation in any given region, and the lines of equal magnetic intensity in that region. Thus in the west of North America and east of Asia they coincide with zone No. 1; in the east of North America, in Central Europe, and in the south-west of Asia with zone No. 2; in the Parimean region of South America, and the Kong and Komri mountain region of Africa, as also in the central regions of Asia, with zone No. 3; in Scandinavia with zone No. 4; in the Ural Mountains, with zone No. 6; and on the south-eastern side of Africa and the Yabloni Mountain region of Asia, with zone No. 7.

Beaumont has the honor of having first developed the doctrine of parallel lines of elevation. His observations apply chiefly to Europe, and have great merit. He classifies the lines of elevation in Europe alone into nineteen systems, assigning a definite age to each. It seems to me that he obtains this large number, in consequence of two misconceptions, that were likely to occur in the early study of this subject, especially in Europe, where the great typical zone is not present at all to an appreciable extent. The first mistake consists in his indicating the systems by ascribing to them definite directions with regard to the cardinal points, and thus failing to take into account the difference in this respect produced by a difference in longitude; and the second that he did not sufficiently take into account the principle of successive epochs of activity along the same lines of elevation. I find, however, that he has attempted a generalization which would include all the chief mountain ranges of the earth, and which I give in the words of E. Lambert in his "Cours Eléméntaire de Geologie."

Les lignes parallèles, considérées par M. de Beaumont, sont des arcs de grands cercles du sphéroïde terrestre qui, prolongés, vont toutes concourir en un point, qui serait le pòlê d'un autre grand cercle perpendiculaire à ceux des systèmes; mais dans une petite étendue les arcs peuvent être considérés comme parallèles.

M. de Beaumont considers the parallel lines to be arcs of great circles of the earth which, if prolonged, would all meet in a point which would be the pole of another great circle perpendicular to those of the systems, but that for short distances the arcs referred to may be considered as parallel.

The defect of this admirably simple and complete theory is that it is not in accordance with the facts. I confess some astonishment, too, at his getting his nineteen European systems to conform to it. The circumstance that gives it a certain value is that the axial lines of the chief lines of elevation intersect each other in the neighborhood of the two great Archipelagoes.

As a rule the regions in the vicinity of the axial lines of zones or subzones of elevation are slowly rising, and the depressed regions between them are undergoing still further depression. This process may be best observed in Australasia and Polynesia, where the coral rocks and islands may be said to preserve a record of the changes of elevation in regard to the sea-level. It seems to result from lateral pressure in the earth's crust caused by a shrinkage of the liquid interior from loss of caloric.

In describing the zones and pointing out the locality of their axial lines, it will be remembered that I found them, as a rule, to be on the southerly side of the continents—the *apparent* development of the zones being on their northerly sides. This in connection with the greater intensity of the plicating forces in the vicinity of the axial lines, explains why the southerly slopes of the continents are steep and abrupt, with high mountains near the sea, and deep sea near the land, and affording many peninsulas and islands. But where in exceptional cases, as South America and Africa, there is an axial line (zone No. 3) extending along or near its northern part also, we find a rapid and abrupt descent from the Venezuelan coast range and the Atlas mountains, to the remarkably deep Caribbean and Mediterranean seas, characterized by Archipelagoes.

As the lines of elevation of zones Nos. 1, 2, 5, 7, have their intersections with the equator at an angle of approximately 45 deg. it follows that within some fifty degrees on each side of the equator, very many of the more important lines of elevation have the directions of north-east or of north-west (approximately); and as the lines of elevation of zone No. 3 are approximately east and west, and those of the other two zones—Nos. 4 and 5—intersect the equator nearly perpendicularly, it follows that within the fifty degrees on each side of the equator the remaining lines of elevation will be east and west, or north and south (approximately). It will be remembered that our own Province is one illustration; the four systems of lines of elevation which I have indicated as being found in Nova Scotia have these directions; and any country in the world (within fifty deg. of the equator) will constitute another. In the Polar regions, and their vicinity, it is for an obvious reason impossible to assign any definite directions to the Mountain ranges generally.

From what has been said it appears that the structure of a country—the stratification of its rocks—depends chiefly upon the mode in which the various systems of parallel lines of elevation intersect each other there. The region of the Alps being at once specially well known to geologists, and specially remarkable in itself, is a good illustration. The lines of zones Nos. 2, 3, 4, 5, and 6, can be distinctly made out; hence its complicated structure.

It is evident that the various zones and subzones of elevation largely affect the currents of the ocean, and of the atmosphere; thereby determining the denudation and formation of rock, and largely affecting the distribution of plants and animals. Thus the Atlantic equatorial current, being finally stopped in its westwardly progress by zone No. 1, forms a great current known as the Gulf Stream, which bears the warm waters and some of the organic productions of the tropical regions along the west coast of Europe to the Polar Regions beyond Spitzbergen. If we compare the Sahara of Africa with the silvas of the basin of the Amazon, we see the effect produced by having a zone of elevation on the eastern side of a tropical country thus intercepting the moisture of the prevailing winds.

The intersections of several subzones sometimes form basins which have no outlet to the sea for their drainage, and therefore form lakes, which, since their waters are carried off only by evaporation, and thus leave their salts behind them, are necessarily salt. The most important basin of this kind is in the greatest subcontinent—Asia-Europe—and has an extent about equal to Europe, the United States, or the Dominion. The more important lines of elevation, especially when they have a direction approximately east and west, form almost impassable barriers to the migration of many plants and animals, on account of the low temperature everywhere prevailing at a considerable elevation above the sea-level. The Himalaya mountains present perhaps the best illustration. As the more important lines of depression are in regions covered by the sea, these also serve as barriers to the migration of most land plants and animals. Thus the narrow seas separating Asia from Australia, separate regions whose fauna and flora are as unlike each other as we might expect to find those of different planets. Scarcely less relatively important have been the effects of the more important lines of elevation and depression on the development of the human race, as these chiefly have determined the migrations and nationalities of mankind.

> "Mountains interposed
> Make enemies of nations, who had else,
> Like kindred drops, been mingled into one."

The course of civilization has been along the subzone of Peninsulas belonging to zone No. 2, on the south-west of Asia-Europe; and our American cousins would say thence across the Atlantic to the Appalachian subzone, also of zone No. 2. Not only is inter-communication by the more primitive methods much more feasible along the prevailing lines of elevation of any region, but these also usually determine the location of railways and canals. The Caledonia canal constructed along a line of depression of zone No. 4, may be taken for an example. It would be easy to show the great importance for the purposes of civil engineering, of an accurate knowledge of the lines of elevation and depression of any country, nor is the importance of such knowledge relatively any less for military purposes. Zone No. 1 seems to date, as to the elevation of much of it above the sea, to the close of the Secondary or Mesozoic period; zone No. 2 from the close of the Paleozoic, and zone No. 4 from the close of the Azoic period. It is probable that each zone, in its turn, had an apparent development comparable to that of zone No. 1 at the present day—giving approximate continuity to the land surface of the earth. That such is the case may, I think, be proved from the distribution of existing plants and animals and of fossil remains, but the limits of a paper forbid my entering upon the subject at present. The same reason forbids my indicating more particularly the terrestrial forces which seem to me adequate to produce the zones of parallel lines of elevation, and to have broken up each successively into subzones.

ART VI. ON PRE-CARBONIFEROUS ROCKS OF THE PICTOU COAL FIELD. BY THE REV. D. HONEYMAN, D. C. L., F. G. S., MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE, &C., *Director of the Provincial Museum.*

(*Read Feb.* 12, 1872.)

ABSTRACT.

IN my last paper I showed that Sir W. E. Logan's opinion relative to the Devonian age of certain rocks in the northern part of McLellan's Mountain, and the district of Sutherland's River, was contrary to the evidence of palæontology and stratigraphy. I shall proceed further to examine the character of the evidence upon which the opinion is based.

The supposed Devonian Rocks on the west side of East River which are considered by Sir W. Logan to be " somewhat similar" to those of McLellan's Mountain, are indicated on Sir W. Logan's map, by a Devonian coloured area on the north-west. These pre-carboniferous rocks of Waters' Hill are regarded by Dr. Dawson as " probably of Devonian age"—vid. page 319 of Acadian Geology, 2nd Ed. It will be observed that this cautious expression hardly warrants the positive conclusion which Sir W. Logan derives from it.

At the time when I read the report I had not seen the rocks of this locality, Waters' Hill, in the north-west corner of the Pictou Coal Field. I therefore examined the map already referred to in order to get some idea of the relative position of the rocks in question. I was astonished to see Devonian rocks having insulated patches of millstone grit, and to find a limestone quarry in Devonian rocks, as all the limestone quarries with which I am acquainted in Nova Scotia, and Cape Breton besides, are of Lower Carboniferous age. On referring to Mr. Hartley's report, I found that the limestone of this quarry was included among the pre-carboniferous rocks. I visited the locality and examined the rocks. Through the kindness of Mr. Dunn, of the Drummond Colliery, I was taken by railway to the point where the line cuts Waters' Hill. Here I found Lower Carboniferous grits underlaid by olive coloured slates and banded quartzites. The last are also overlaid by conglomerate. The slates and quartzites exactly resemble the rocks of the west side of anticlinal No. 2, as seen in the brook that proceeds from Blanchard's to East Branch, East River, or the Clinton strata that contain the new bed of Blanchard, which are continued on the west side of Fraser's Mountain, whose counterpart are the strata which are continued at McLellan's Mountain, Sir W. Logan's Devonian rocks. This is certainly striking, and shows that Sir W. Logan was right in his comparison, although he was somewhat astray in his conclusion.

I am not aware of the consideration which induced Dr. Dawson to express the opinion that the rocks of Waters' Hill are probably of Devonian age, in preference to the opinion that they are probably of Silurian age. I would now, then, in consideration of the absence of the Devonian in the extensive and well developed region to the east of the Coal Field, and the obvious lithological resemblance existing between the rocks of the Middle Silurian series of anticlinal No. 2, infer the Middle Silurian age of the pre-carboniferous rocks of Waters' Hill. Lithological, stratigraphical and palæontological evidence, evidently favour this conclusion. Having examined this interesting section of middle silurian rocks, I went in search of the Limestone quarry. Instead of the top of the hill I found it near the bottom. I had not the least difficulty in ascertaining the geological relation and age of the Limestone. It is evidently a metamorphosed Lower Carboniferous Limestone, much contorted with a beautiful manganese florescence, or flowers, as they are styled by the quarrymen, resting directly and unconformably on the Middle Silurian slates.

The strata at East River, which have been indicated as resembling the rocks of the section, are also overlaid directly and unconformably by Lower Carboniferous Limestone with associated green pyritous marble.—Vide Transactions, 1870–71, pp. 64. In all probability the Middle Silurian strata of Waters' Hill participated in the pre-carboniferous and post Lower Helderberg movement, which elevated the strata of McLellan's and Irish Mountains; and ~~that they~~ consequently formed part of the Silurian boundaries of the Lower Carboniferous Lagoon, which subsequently became the Pictou coal basin. They evidently formed a barrier on the North against which dashed the waves of the sea throwing up the beach and bar which is now known as the New Glasgow Conglomerate, preserving comparative quiet in the sheet of water within, and affording protection and comfort to the marine Radiata, Mollusca, and Pisces of the period, the Lithostrontia, Crinoidea, Brachiopoda, Lamellibranchiata, Gasteropoda, Heteropoda, Pteropoda, Cephalopoda, and Cochliodus, which have left so many enduring monuments in the beautiful ornamented limestones formed in the inside of the barrier itself,—in the limestones of McLellan's Mountain shore,—in the Gypsum of Irish Mountain,—in the Lithostrontian and other Limestones of Springville, and in the Gypsum Limestones and marble of East Brook, East River.

Art. VII. On the Meteorology of Caledonia Mines, Little Glace Bay, Cape Breton. By H. Poole, Esq., M. E., *Superintendent of Mines*.

(*Read March* 11, 1872.)

In commenting upon the Meteorological phenomena recorded in the accompanying table, which now embraces a period of five years, I would in the first place draw attention to the general results shown during that period.

The mean Barometrical readings corrected to 32° were 29.8428, and corrected for 60 ft. of altitude and force of vapour, 29.6439; and the mean temperature was 40.35. The mean at night being 34.466, and the mean at noon being 46.184 degrees of Fahrenheit.

The mean force of vapour was ·2560 inch; and the relative humidity was 73.50, saturation being 100. The mean annual velocity of the wind was 153,457 miles; or 17.5 miles per hour. The fall of rain and melted snow averages 58.898 inches on 157 days; the fall of snow averaging 104.5 inches on 59 days. The nights of frost average 185, or one half of the year. The degrees of frost reckoned from 32 average 1998 degrees. Nights below zero average 7.8; rimy frosts average 36.4; hail 6.8; silver thaws 6.4; fogs 45; lightning and thunder 11.6; rainbows 9.2; auroras 54; halos round sun 31.4, and halos round moon 8.6; corona 3.4; wind veered with the sun 37.6 times, and backed 12 times. The average direction of the wind was 126 days from S. to W.; 105 days from W. to N.; 76 days from N. to E., and 58 days from E. to S.

Upon comparing the mean of the year 1871 with the average of the 5 years observations, it will be noticed that the barometer read .0513 inch lower; the thermometer .51 degree lower; the temperature at night being .236° and at noon being ·724°. The force of vapour was .0037 inch less; and the relative humidity was 4.75 per cent more than the average.

The velocity of the wind is unusually high at this station, and I have therefore thought it desirable to comment upon the gales more in detail, than in former reports.

In January the wind averaged 19.70 miles per hour for the month. The greatest velocity recorded in 24 hours was 1257.60 miles on the 9th. The calmest day was 92.80 miles on the 12th. The first gale began before dawn on the 6th, from S. S. W. with snow and rain; corrected barometer 29.982 at 2 p. m. Rain ceased at 2 p. m. on the 7th; wind veered round to W. N. W. and calmed down. The thermometer did not register below 45 degrees during the night of the 6th. The second gale began at 3 p. m. on 9th; the barometer at 30.081, thermometer 23°, and wind N. by E., then N. E. to N., N. W., and W. with snow for the 24 hours. The third gale was on the 25th, W. N. W. The barometer reading 30.067; thermometer —7° on 26th; the wind blew from the N. all day: next day it backed to S. W., W., N. with snow and moderated.

In February the wind averaged 18.14 miles per hour. It was unusually calm on the evening of the 17th. Wind registered 109.6

miles in the 24 hours from S. S. E. The gale came on at night, and at 8 a. m. of the 18th registered 1273.60 miles for the 24 hours previous; wind then S. W. and moderated; the thermometer then at 44°. The barometer fell from 30.122 to 29.260. 1.110 inch of rain fell from 8 p. m. to 8 a. m. of the 18th. Another gale commenced on the 28th at night with wind from N. W., barometer rising up to 30.031, and lowest reading of thermometer at 10°.

On 1st March at 8 a. m., a fine display of parhelia with colored arcs of halos with wind S. S. W., then S. W., S. E., S. S. W, N. W., N. N. W., N. E., to S. S. E., when it fell calm at 6 p.m. on the 2nd. Gale came on again at night of the 3rd from S. W. with rain; changed to N. N. W. at midnight and moderated. The mean velocity of wind for March was 20.09 miles per hour, the highest registered was on the 22nd, 922.4 miles in the 24 hours; the calmest day was the 18th, 144.80 miles. The second gale began at 1 a. m. on the 22nd from the S. E. with rain, then S. W., W. S. W., W., E. Wind calmed at 6 p. m. on the 23rd; only marking 6.20 miles in 14 hours up to 8 a. m. on the 24th. The barometer fell from 30.363 at 9 p. m. on the 20th to 29.157 at 9 p. m. on the 22nd. Between 1 a. m. and noon of the 22nd, 1.39 inch of rain fell.

In April the mean velocity was 18.40 miles per hour. The highest wind was on the 18th, 1272.80 miles in 24 hours. The gale marked 58 miles per hour from 8 a. m. to 6 p. m., N. by E., N., N. by W. 3 inches of snow fell, and barometer read at 2 p. m. 29.391. Gale lasted till 6 p. m. on the 19th. The calmest day was 108 miles on the 14th with wind N. E. Another gale began at night of the 5th from N. E. with snow, it continued all day of the 6th from N. N. E. to N. N. W.; the barometer marked 28.957 at 8 a. m., and the wind gauge registered 68 miles per hour from 8 a. m. to 1 p. m.

In May the wind averaged 17.95 miles per hour. The first gale was on the 20th when the gauge marked 872.80 miles in 24 hours from W. S. W., the barometer reading on the 20th at 8 a. m. 30.091, and on the 21st at 8 a. m. 29.933. The calmest day was the 21st, or 99.20 miles in 24 hours with wind S. S. W. A gale commenced on the 27th with rain and fog from N. W. at

2 a. m. until 5 a. m., with lightning and thunder from 2 to 3 a. m., then snow from 10 a. m. to 4 p. m., with wind from N. N. W., and the gauge registered 44 miles per hour from 8 a. m. to 2 p. m., and 66 miles per hour from 2 till 6 p. m. Half an inch of snow fell, being the last of the season.

In June the wind averaged 12.18 miles per hour. The first gale was on the 5th from the N., and cloudy. On the previous day the wind was brisk and had veered round with the sun; the barometer stood at 29.781 at 2 p. m. on the 4th, 29.610 on the 5th, and 29.790 on the 6th. The wind travelled 970.80 miles in the 24 hours. The next gale was on the 11th and 12th. The barometer stood 30.045 when the gale commenced, weather fine with wind S. by E. to S. S. W., and registered 860 miles for 24 hours up to 8 a. m. on the 12th; the barometer then read 29.793, wind S. S. W. with showers and S. at noon; on the 13th at 8 a. m. the barometer had fallen to 29.454 with rain and wind S. S. W. and registering 1121.20 miles for the 24 hours; later in the day the wind veered to S. W. and moderated.

July was the calmest month; the average being 11.60 miles per hour. The strongest blow on the 2nd only registering 594.40 miles in 24 hours, weather fine, wind S. S. W., and barometer reading from 30.097 to 29.846. The calmest day was the 24th, the register marking 48.60 miles for 24 hours, wind N. N. W., to N. E., and barometer at 30.163.

In August the wind averaged 16.52 miles per hour. There were high winds on the 9th and 30th, being 699.20 miles from S. E., E., and N. E. on the 9th, and 656.00 miles on the 30th from S. S. W.; but neither of them amounted to a gale.

In September the wind averaged 15.32 miles per hour. The calmest day was the 1st, marking 128.60 miles in 24 hours. The strongest wind on the 27th, 668.20 miles, did not amount to a gale; the barometer fell from 30.035 to 29.572 with rain and wind from E. S. E., S., S. W., to W. by N., so that there was not any equinoctial gale.

The wind in October averaged 16.42 miles per hour. On the 7th there was a heavy rain from 10 a. m. to 12 a. m. of the 8th, measuring 1.95 inch, blowing from S. S. W., N. W., N. by E., back to N. by W. The barometer fell from 29.859 to 29.616. The next gale began at 8 p. m. of the 12th. The wind had been S. S. W. all day, backed to S. S. E. at night, and next morning was W. S. W.; the total revolutions were 1076.60 miles in the 24 hours, and from 8 to 9 a. m. the gauge marked 64 miles for the hour. The barometer fell from 30.136 at 8 a. m. to 29.391 at 11 p. m.

November was the most stormy month of the year; the wind averaged 22.82 miles per hour. The first storm began on the 2nd, and lasted for three days, and was severely felt at St. John, New Brunswick. The gale blew from W. N. W. with snow, and the guage marked 797.40 miles at 8 a. m. on the 3rd; wind W. N. W. to N. W., and marked 756.60 miles at 8 a. m. on the 4th; wind backed W. by N. to W., and marked 779.20 miles at 8 a.m. on the 5th. The barometer was at 29.894 on the 1st, and fell to 28.945 at 9 a. m. on the 2nd; stood at 29.325 on the 3rd; 29.424 on the 4th; and 29.414 on the 5th. The second gale began on the 12th and also lasted three days, commencing from the N. N. W. and veering to N. N. E. with rain and snow, the barometer marked 29.329, and gauge registered 1280.80 miles at 8 a. m. on the 13th, when it blew from N. to N. by W., and barometer marked 29.791. At 8 a. m. on the 14th the wind blew from N. by E., and so continued all day, the barometer read 30.046 and the gauge marked 1368 miles. At 8 a. m. on the 15th the wind blew from N.; the barometer stood at 30.088, and the guage read 680.60 miles for the 24 hours; after which time it moderated with wind veering to N. N. E. and snowing; so that this gale continued with a rising barometer. On the 16th the wind only registered 141 miles for 24 hours blowing from E. N. E., and barometer at 29.882. At 5 p. m. of the 17th the gale sprang up again from N. by E.; the barometer had fallen to 29.596 at 8 a. m., and on the 18th at 8 a. m. it rose to 29.900, and the guage marked 980.80 miles with wind from N. N. E. On the 19th at 8 a. m. the barometer marked 30.170 wind backed to N. W., and gauge marked 710.80 miles. The next day was calm, marking only 81.20 miles in the 24 hours; barometer 30.187, and wind S. W. by W. On the 22nd the barometer fell from 29.694 at 8 a. m. to

29.136 at 5 p. m., and 1.55 inch of rain fell in 35 hours, the wind blowing S. E., S. S. E., S. and S. S. W. The guage marked 34.5 miles per hour from 8 a. m. to 1 p. m., 48 miles from 1 to 2 p. m., 73.74 miles per hour from 2 to 5 p. m., and 69.75 miles per hour from 5 to 9 p. m., and 16 miles per hour from 9 p. m. to 8 a. m. on 23rd: total for 24 hours 923.20 miles. The next gale began on the 25th at 10 a. m. The barometer had marked 30.477 on the 24th, and stood at 29.969 at 8 a. m. on the 25th, and fell to 28.856 at 6 p. m., the wind blowing from E. S. E. to E. by S. At 1 p. m. the gauge gave 42.5 miles per hour from 10 a. m. From 1 to 5 p. m. it marked 65 miles; and a total of 1187 miles for 24 hours. Some rain fell, but there was no frost: while at Alta City, Utah, 6 feet of snow fell, and the thermometer marked –20; and at Ottawa —10. The gale continued on the 26th, the wind blowing N. by W., N. N. W. From 8 a. m. to 10 a. m. the wind marked 62 miles per hour; 10 to 11 a. m., 73.6 miles; 11 to 12 a. m., 65 miles; 12 a. m. to 1 p. m., 61.6 miles; 1 to 2 p. m., 69.4 miles; 2 to 4 p. m., 58.3 miles; 4 to 6 p. m., 50.5 miles; 6 to 9 p. m., 39.1 miles, when it moderated, and only read 7.17 miles per hour from 9 p. m. to 8 a. m. on the 27th, the wind veering N., E., S., N. W., N. E. during the day. The total miles being 807.60 for the 24 hours.

In December the average velocity was 17.95 miles per hour. On the 4th the barometer 30.172 with wind S. W. at 8 a. m, backed to S. S. E. and blew 808.40 miles in 24 hours. On the 5th at 8 a. m. the barometer was 29.231, wind S. E. with rain, which measured 1.20 inch from 10 p. m. to 10 a. m. The wind blew 54 miles from 8 to 9 a. m. from S. From 9 a. m. to 1 p. m. 37.5 miles per hour from S. W. Barometer fell to 29.187 at 2 p. m. From 1 p. m. to 8 p. m. 28 miles per hour; and a total of 696 miles for 24 hours. A gale began on the night of the 21st from W. by S. and the barometer had risen to 29.345 from 28.981 at 5 p. m. of the 24th, and the thermometer marked –1° at 8 a. m. of the 22nd, and wind gauge registered 812.80 miles for the 24 hours. On the 24th a gale sprang up at 5 a. m. from S. W., and snow turned to rain; the barometer at 29.646. From 9 a. m. to 12 a. m. it blew 48.20 miles per hour; from 12 a. m. to 2 p. m.

39.5 miles per hour, wind W. S. W.; from 2 to 3 p. m. 62.2 miles per hour. The barometer went up to 30.088 at 8 a. m. on the 25th, and the wind had backed round two whole revolutions during the night of the 24th. On the 27th the barometer was 29.996 at 8 a. m. and fell to 29.175 at 9 p. m. with wind from S. E. to S. S. W. with snow and rain 0.58 inch; wind measured 793.40 miles for the 24 hours.

Of the 40 gales during the year, nine began between South and West, of which five veered, and four backed. Twelve began between the west and north, of which ten veered, and two backed. Four began between north and east and all backed. Nine began between east and south, of which seven veered and two backed. The greatest velocity measured was on the 22nd November from 2 to 5 p. m., averaging 73.74 miles an hour; or from 2 to 9 p. m., the 7 hours averaged 71.47 miles per hour.

The calmest day in the year was the 24th July, when the gauge only registered 48.60 miles in 24 hours; and for the days 23, 24, and 25, they only marked 181 miles, or a rate of 2.5 miles per hour.

During the year the wind made 43 complete revolutions with the sun, and 23 revolutions against the sun, which were recorded by a string fastened to the pedestal as well as to the arrow of the vane. The wind made two turns round with the sun on the 27th May, and made two revolutions backward on the 24th December through the night.

The other notes recorded in the year are:

January 24th.—Sleighs passing over ice, Big Glace Bay Lake.

February 12th.—Two Eagles "Halialus leucocephalus," seen. 19th.—Grey gulls and wild ducks.

March 7th.—Four wild geese in the bay. 11th.—Flock of robins. 17th.—Seals seen on ice about 4 miles off.

April 7th.—Heard first greybird singing.

May 1st.—Flock of curlews. 3rd.—Heard woodpecker. 6th.—Gathered mayflowers, "Epigea repens," in bloom. 7th.—Cranes, curlews and yellowlegs. 8th.—Herrings and codfish caught in the bay. 9th.—Frogs croaking. 10th.—Frogs piping. 12th.—Saw bee and snake. 13th.—Kingfishers seen. 18th,—Gaspereau passing up Big Glace Bay. 19th.—Swallows seen.

20th.—Musquito hawk heard. Poplar catkins in bloom. 21st.—First butterfly, "Camberwell beauty," seen. 22nd.—Coltsfoot, violets, strawberries, golden thread, birch catkins bloom. 23rd.—Dandelions bloom.

June 16th.—Apples and plums in blossom. 25th.—Caterpillars on gooseberries. 29th.—First firefly seen.

July 4th.—Wild strawberries ripe. 16th.—Garden strawberries. 19th.—Mackerel caught in herring nets. 23rd.—Gathered peas. 26th.—Mowing hay.

August 3rd.—Dr. How, of Boston, coming from Mabou by stage, saw a very bright Meteor pass through arc of about 30 degs., from 3 to 5 minutes later all the passengers heard a report like a quarry blast. 4th.—Saw a shark in Glace Bay. 13th.—Curlew and plover arrived.

September 15th.—Wild geese in the Bay.

October 9th and 10th.—Country full of smoke from Chicago fire? 29th.—Cock-a-wee, "Harelda glacilis," in Big Glace Bay.

December 4th.—School of black fish (3 killed) came into Glace Bay. 22nd.—Teams cross ice in Big Glace Bay Lake.

Art. VIII. Extract from H. S. Poole's letter, respecting a Journey to Deep Creek Valley on the Nevada frontier; 150 miles from Salt Lake City.

(*Read March* 11, 1872.)

We had to take the same horses and buggy all the way through, as no relays can be got on the way. For the first 50 miles we skirted along the margin of the Great Lake, which in all the southern parts is exceedingly shallow; then we turned south up the Skull Valley, and bid good bye to all signs of civilization. We ascended the Cedar Mountains to the top of a pass 1800 feet above the desert; which seemed to lie at our feet, spread out for 100 miles to the north west, and 45 miles in the opposite direction; and to the left for 20 miles until short ranges of mountains hid its continuations southward.

es	Snow.															Wind.					
																Turned.		True N.			
Days.	Inches.	Days.	Nights of Frost.	Degrees Frost.	Below Zero.	Rimy Frost.	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	With Sun.	Against Sun.	S. to W.	W. to N.	N. to E.	E. to S.
16	25.00	13	27	497	3	4	...	1	3	...	...	2	2	1	1	1	2	11	12	5	3
14	5.00	9	26	512	3	9	...	4	3	...	...	4	4	4	4	5	1	7	13	5	3
14	12.50	9	27	260	...	3	...	4	6	...	...	5	9	3	...	4	2	10	7	9	5
16	24.00	12	29	175	...	4	2	1	7	...	...	7	7	1	..	3	1	3	8	12	7
16	1.00	2	17	15	...	11	...	...	7	3	2	7	6	1	1	7	2	11	13	6	1
13	......	...	4	3	...	3	...	...	11	3	1	4	8	...	...	5	1	9	6	6	9
11	......	...	....	.....	...	..	...	...	14	3	1	5	6	1	..	5	2	14	2	9	6
16	.....	...	....	......	...	...	...	..	5	3	2	8	3	2	1	1	......	13	7	7	4
15	......	...	6	......	...	6	1	...	4	...	5	7	3	1	1	4	2	12	11	4	3
16	0.25	1	11	12	...	8	1	...	7	2	1	5	3	...	..	4	2	13	8	5	5
18	8.75	10	23	111	...	8	...	...	1	..	2	11	2	...	..	2	3	10	10	8	2
20	32.50	18	31	458	2	1		...	3	...	1	2	4	1	..	2	5	20	3	6	2
......	....	.	...	......	..	...	...	...	..	..	..	...	...	..	...	......	......	...	...	..	..
185	1090	74	200	2043	8	57	4	10	71	14	15	67	57	15	8	43	23	133	100	82	50

METEOROLOGICAL REGISTER, CALEDONIA MINE, LITTLE GLACE BAY, CAPE BRETON. 60 FT. ABOVE SEA. LAT. 46° 12′ N. LONG. 59° 57′ W.

1871.	Barometer. Corrected to 32°.	Barometer. Correc. for Vapor & 60 ft. above Sea.	Barometer. Highest Corrected.	th.	Barometer. Lowest Corrected.	nd.	Thermometer. Mean	Thermometer. Mean Night	Thermometer. Mean Day.	Coldest. Night.	th.	Coldest. Day.	rd.	Hottest. Night.	th.	Hottest. Day.	th.
January	29.6561	29.5778	30.688	20	28.916	22	22.03	17.56	26.51	–8	24	–3	23	45	7	50	17
February	29.7417	29.6928	30.314	24	28.771	4	19.15	14.00	24.10	–5.5	5	1	5	35	28	44	1
March	29.8213	22.7240	30.363	20	28.951	28	29.72	24.00	35.45	10	1	24	16	37	13	53	11
April	29.7490	29.6436	30.265	28	28.957	6	32.48	26.80	38.17	11.5	2	27	1	33	30	53	4
May	29.7319	29.5624	30.349	5	29.126	7	42.71	36.00	49.42	28	5	32	27	57	23	81	21
June......	29.7855	29.5207	30.045	11	29.454	13	52.18	44.27	60.10	29	2	41	3	61	30	78	29
July	29.8908	29.4856	30.283	30	29.428	8	60.50	55.00	66.00	44	2	57	5	62	29	81	6
August	29.8652	29.4295	30 398	23	29.453	6	63.20	57.50	68.91	44	27	59	28	64	31	83.5	4
September.....	29.9255	29.6190	30.344	9	22.456	17	54.25	47.93	60.57	33	13	52	14	66	6	75	6
October	29.9038	29,6757	30.553	25	29.042	20	46.90	41.32	52.48	25	26	36	21	57	12	71	11
November.....	29.6152	29.5040	30.477	24	28.856	25	32.98	29.33	36.63	10	30	18	30	45	22	53	22
December	29.8122	29.7551	30.719	23	28.981	20	22.00	17.03	27.00	–1	22	9	30	38	7	49	24
Mean..	29.7915	29.5992	....	Dec.	....	Feb.	39.84	34.23	45.46	......	Jan	......	Jan	......	Sep.	.....	Aug
Extreme	....	....	30.719	23	28.771	4	....	....	....	–8	24	–3	23	66	6	83.5	4

1871.	Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
January	.1383	87	3.515	734050	19.70
February	.1089	81	2.766	609690	18.14
March	.1573	84	3.998	747350	20.09
April	1654	81	4.203	662720	18.40
May	.2295	65	5.829	667690	17.95
June......	.3248	72	8.252	438420	12.18
July	.4652	74	11.818	431200	11.60
August	.4957	78	12.592	614970	16.52
September.....	.3665	75	9.209	551680	15.32
October	.2881	78	7.320	611020	16.42
November.....	.1712	84	4.350	821600	22.82
December	.1171	80	2.976	667930	18.95
Mean..	.2523	78.25	.6402	629860	17.34
Extreme	....	....	....	7558320 or151166	.... Miles

1871.	Rain includes Snow. Inches.	Rain. Days.	Snow. Inches.	Snow. Days.	Nights of Frost.	Degrees Frost.	Below Zero.	Rimy Frost	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	Wind. Turned. With Sun.	Wind. Turned. Against Sun.	True N. S. to W.	True N. W. to N.	True N. N. to E.	True N. E. to S.
January	4.840	16	25.00	13	27	497	3	4	...	1	3	...	...	2	2	1	1	1	2	11	12	5	3
February	2.630	14	5.00	9	26	512	3	9	...	4	3	...	...	4	4	4	4	5	1	7	13	5	3
March	6.245	14	12.50	9	27	260	...	3	...	4	6	...	...	5	9	3	...	4	2	10	7	9	5
April	7.830	16	24.00	12	29	175	...	4	2	1	7	...	...	7	7	1	..	3	1	3	8	12	7
May	2.900	16	1.00	2	17	15	...	11	...	...	7	3	2	7	6	1	1	7	2	11	13	6	1
June......	1.560	13	......	...	4	3	...	3	...	...	11	3	1	4	8	...	...	5	1	9	6	6	9
July	4.205	11	......	...	.....	......	...	..	...	...	14	3	1	5	6	1	..	5	2	14	2	9	6
August	4.595	16	.....	...	....	......	...	...	...	..	5	3	2	8	3	2	1	1	......	13	7	7	4
September.....	4.820	15	......	...	6	......	...	6	1	...	4	...	5	7	3	1	1	4	2	12	11	4	3
October	4.325	16	0.25	1	11	12	...	8	1	...	7	2	1	5	3	...	..	4	2	13	8	5	5
November.....	4.150	18	8.75	10	23	111	...	8	...	...	1	..	2	11	2	...	..	2	3	10	10	8	2
December	5.435	20	32.50	18	31	458	2	1		...	3	...	1	2	4	1	..	2	5	20	3	6	2
Mean..	....	.....	....	.	...	......	..	...	...	..	..	..	..	...	...	..	...	......	......	...	...	..	..
Extreme	53.535	185	1090	74	200	2043	8	57	4	10	71	14	15	67	57	15	8	43	23	133	100	82	50

COMPARED WITH THE ABOVE.

Year.	Corrected to 32°.	Correc. for Vapor & 60 ft. above Sea.	Highest Corrected.		Lowest Corrected.		Mean	Mean Night	Mean Day.	Coldest Night.		Coldest Day.		Hottest Night.		Hottest Day.	
1867. Mean	29.8524	29.6704	... ..	Feb.	......	Sep	40.06	34.17	45.95	....	Jan	....	Decr	..	Aug	...	Aug
Extreme	.. ...	....	30.768	11	28.676	30	.....	.....	.....	–10	31	1	31	67	25	85	9
1868. Mean	29.8854	29.6924	......	Mar	......	Feb	39.29	33.64	44.84	....	Feb	....	Feb	....	July	...	July
Extreme	....	......	30.611	6	28.809	6	.. .	....	.....	–13	4	4	22	66	2	89	5
1869. Mean	29.8413	29.6325	.. ...	Decr	......	Feb	40.80	34.43	47.17	....	Jan	....	Jan	...	Sep	....	July
Extreme	.. ....	....	30.590	11	28.886	4	... .	....	.....	–9	23	1	23	69	9	86	29
1870. Mean	29.8433	29.6251	......	Jan.	..	Feb	41.75	35.90	47.50	....	Mar	...	Feb	....	July	....	July
Extreme	....	....	30.560	1	28.460	1	. ...	.....	....	–2.5	13	6	4	69	9	89.5	24

Year.	Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
1867. Mean	.2438	72.87	6.194	643534	17.6
Extreme	.....	. ...	.. ..	7722414 or154448	Miles.
1868. Mean	.2454	74.30	6.233	675908	18.5
Extreme	.....	.....	.....	8110903 162218	Miles
1869. Mean	.2696	68.10	6.849	612927	16.8
Extreme	....	.....	. . .	7355130 or147102	Miles.
1870. Mean	.2691	74.00	67.87	634806	17.4
Extreme	....	.....	.....	7617670 or152353	Miles.

Year.	Rain. Inches.	Rain. Days.	Snow. Inches.	Snow. Days.	Nights of Frost.	Degrees Frost.	Below Zero.	Rimy Frost	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	With Sun.	Against Sun.	S. to W.	W. to N.	N. to E.	E. to S.
1867. Mean	4.841	12	...	.	..	.....	..	..	..	..	..	..	..	..	..	..	..	....	...	...	..	..	..
Extreme	58.090	147	1250	52	172	2171	7	23	5	5	25	9	6	26	16	3	0	36	17	122	114	54	75
1868. Mean	4.974	12.5	945	65	193	2486	15	18	6	3	28	12	6	35	23	7	2	35	5	129	107	76	54
Extreme	59.750	152	.....	..	...	....	..	..	..	..	..	..	..	..	..	..	..	..	....	..	..	..	..
1869. Mean	5.041	11.7	917.5	48	186	1794	6	37	8	6	41	6	7	39	27	6	3	36	9	124	104	81	56
Extreme	60.490	140	.....	..	...	....	..	..	.	..	..	..	..	..	..	..	..	....	....	..	..	..	..
1870. Mean	5.219	13.3	1020	56	183	1499	3	47	11	8	61	17	12	102	34	12	4	38	7	123	99	85	58
Extreme	62.625	160	.....	..	..	..	..	..	..	..	..	..	.	..	..	..	..	...	......	..	..	..	..

CLIMATE OF ALBION MINES, NOVA SCOTIA. LAT. 45° 34′ 30″ NORTH. LONG. 62° 42′ WEST. 120 FEET ABOVE SEA.

10 years.	Corrected to 32°.	Correc. for Vapor & 60 ft. above Sea.	Highest Corrected.		Lowest Corrected.		Mean	Mean Night	Mean Day.	Coldest Night.		Coldest Day.		Hottest Night.		Hottest Day.	
Mean...	29.7135	....	.. ....		......		41.97	33.11	50.91	....		. ..		....		....	
Extreme	....	......	30.757		28.505		....	....	....	–22		....		....	.	98	

10 years.	Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
Mean...	...	....	....	....	.....
Extreme	....	. ..	...	....	.. ..

10 years.	Rain. Inches.	Rain. Days.	Snow. Inches.	Snow. Days.	Nights of Frost.	Degrees Frost.	Below Zero.	Rimy Frost	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	With Sun.	Against Sun.	S. to W.	W. to N.	N. to E.	E. to S.
Mean...	......	....	.. ..	..	...	....	..	..	..	..	..	..	..	..	..	..	..	....	.. .	...	...	..	..
Extreme	44.967	173	1115	63	187	2470	19	...	...	...	...	19	...	...	...	...	...	....	....	112	126	66	61

RAIN-FALL COMPARED.

YEAR.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Septr.	Octr.	Novr.	Decr.	TOTAL.
1867.......	5.915	5.395	5.965	5.085	5.370	2.010	3.080	2.560	11.265	2 920	4.780	5.745	58.090
1868.........	4.665	5.545	3.945	5.320	3.145	6.057	2.122	3.428	6.956	7.745	5.700	5.120	59.750
1869.........	3.610	5.820	6.005	4 420	7.400	3.300	6.400	2.728	2.870	7.220	5.065	5.655	60.490
1870.........	6 550	7.605	3.980	3.870	1.705	2.475	2.120	3.310	6.575	6.195	9.065	9.175	62.625
1871.........	4.840	2.630	6 245	7.830	2.900	1.560	4 205	4.595	4.820	4.325	4.150	5.435	53.535
Mean	5.116	5.399	5.228	.5305	4.104	3.080	3.585	3.324	6.497	5.681	5.752	6.226	58.898
1867.........	10	5	11	7	8	1	4	2	12	3	6	9	
1868.........	5	8	4	7	2	10	1	3	11	12	9	6	
1869.........	4	8	9	5	12	3	10	1	2	11	6	7	
1870.........	8	10	6	5	1	3	2	4	9	7	11	12	
1871.........	9	2	11	12	3	1	5	7	8	6	4	10	
Meau........	5	8	6	7	4	1	3	2	12	9	10	11	

HENRY POOLE,
Caledonia Mine, Cape Breton.

The third day brought us shortly after dark to Granite Mountain, some 2000 feet high, standing alone in the desert; here we expected to find water, and so we would if we had not chosen the wrong spring, and therefore had to eat a dry supper, and wait until morning to seek another spring four miles distant, before we could water the horses. A few dried up limbs of stunted cedar warmed us before we rolled ourselves in blankets, and bid defiance to Jack Frost.

The fourth day brought us to Deep Creek, and within gun-shot of Nevada. Bidding adieu to the shelter of the mountain, we first crossed a sandy tract, enclosed by a long mound of sand some 20 feet high, that encircled more or less completely the old Island Mountain, as a barrier to the waves of the ancient shallow sea; then we entered on the desert in the strictest sense of the term, and crossed a bay of it, some twenty miles wide, level as a table, without a mound, or wind-blown elevation, destitute of vegetation, even to the absence of the sage-bush and grease-wood, without the track of a badger or coyote. A slight fall of snow two days previous had moistened the upper layers of salt mud, usually baked hard and dry, which made hard travelling; the horses balling more than I ever saw them do in snow, and the narrow tyres of the wheels were made four inches wide.

While traversing this deserted though highly interesting region, the mirage showed many unaccustomed pictures. We appeared to be crossing a small island whose margins seemingly at no great distance continually eluded our approach: the isolated ranges looked like islands set in a sea of glass, upon whose surface every feature, bold, bare, and rugged, was faithfully pourtrayed.

Well on in the afternoon we reached some springs quite at the foot of the ancient beach, up which, after a short rest, we wound our way for five miles, gaining an altitude of 1100 feet above the desert. The beach showed many signs of periods of rest during the subsidence of the lake. Great beds of white limestone intercalated with the gravel were cut through by the scour of the declining waters.

I found the mines easy of access, at an altitude of about 7000 feet, and my report being considered satisfactory, the property has been bonded for $45,000. Some of the ledges were in granite, and carried galena containing $210 of silver to the 2000 pounds. One location I visited, not bonded, had two shafts sunk 25 feet deep, 100 feet apart, both showing solid carbonate ores valued at $56 per ton. The width of the deposit has not yet been proved, or the length either. Returning we came by the old overland route, now deserted, and got safely through the sloughs where, in olden times, so much mail matter was used as ballast; we passed high crags of black limestone; passing the "divides" of the Dugway and Point of the mountain into Rush Valley. We were four days also in returning: the last day doing 65 miles from 7 a. m. to 2 a. m. We camped out also once on returning near the Dugway, and had rather a cold night, for one inch of ice formed in the puddles from the melted snow accumulated the day before. Other nights we slept on the floor of cabins, or small shanties.

Art. IX. On the Construction of a Beaver Dam in Digby County, Nova Scotia, Sept., 1871. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read March* 11, 1872.)

On the 14th September, 1871, we left the town of Digby, and skirting along the southern ridge of those low Silurian hills which under the name of South Mountain, Horton Mountain, and Ardoise Hills, run north-east and south-west almost the entire length of Nova Scotia, we came after descending their southern slope to the lake basins forming the upper waters of the Sissiboo River, falling into St. Mary's Bay.

We passed Grand Lake, having now abandoned our horses for canoes, and were floated gently over lakes, lakelets, rapids, and still waters, till on the 18th we camped at South-west Falls, about thirty miles south of Digby. Here the granite, that we had on our left almost from Digby, occurring in dykes of porphyry, with large crystals of white felspar, pervaded the whole scene. The lakes were studded with granitic boulders, their milky-white shores were granite sand, the rapids foamed through boulders, and we toiled over rocky portages of the same. It had lost its porphyritic character, resembling the Shelburne granite of the sea coast, except here and there an erratic of the red or Egyptian variety—which lay fastly disintegrating and poised on the summits of the white.

That the country still rose south of us for ten miles, and was still granitic; and that on either hand we were bounded about twelve miles to the right by the Silurian slates through which the Sissiboo pours the most beautiful fall in Nova Scotia; and about the same distance to the left by the Bear River hills, also Silurianis;—all we can vouch for, leaving it for the future Geological Report to confirm if the granite is continuous with that on the sea coast, or if it disappears beneath the slates of Fairy Lake and the great Rossignol.

Soon after leaving camp on the 19th, James Meuse, our Indian hunter, pointed out to us a beaver dam. The stream flowing gently out of a long still water was narrowed to about twelve yards by granite boulders on either side, one or two of which projected out of the middle. Here was the spot they had chosen, their object being to raise the water of the still water about eighteen inches. They had first dammed the stream to a rock about ten feet from the shore, then thrown the dam to a second rock lying up stream, and from thence carried it to the opposite side. It resembled a brush water fence, the water falling about eighteen inches, and pouring over and through white bleached sticks and twigs of trees lying in the water, with their butts up stream, otherwise laced and interlaced in endless confusion. It was of a horse-shoe form, its convex side lying up stream.

From observations as far as the height of the stream would allow, and from the remarks of James Meuse, a very intelligent Indian, I could only conclude that the beavers formed their dams by first choosing a narrow part of the stream studded by rocks, and then felling down trees up stream, which they floated down with their butts up stream until they grounded in the narrows. Thus soon a number of trees would be lying parallel, butts up stream, and branches down, and interlaced in endless confusion. The beaver then gnawed the butts off, and floated them athwart or crossways the branches. In this he is assisted by the rocks in the bed of the stream. An obstruction now being made to the water he fills in the interstices with mud, with stones, and especially dried grasses, which abounded on the margins of the stream, hay, as every practical man knows, being a capital substance for stopping a water breach. This structure was evidently of a late formation, and small in comparison with those we read of in the north-west territories. It probably held a community of ten or twelve.

It is idle to describe the sylvan beauty of this scene: the sweet music of the water trilling through its milk-white and endlessly interwoven barriers,—the deep green of the waving grasses,—above dam, the still water losing itself in a reach, or in the reflections of the dark overhanging pines,—the perfect water carpet of lily pads, and the solitude steeping this scene dedicated to instinct labor. Our canoe was floating above dam, its graceful bow held lightly in the interlacing twigs, and a few sweeps of the paddle carried us across the still water, some five hundred yards to where the owners of those mill privileges had built their homes. Standing in and out the water, there literally carpeted by lily pads, and embayed by the thick water grasses, and cranberry bushes, were two domes. A twist of the paddle and we grounded on its white and withered thatch, the beavers escaping under the water.

On the sloping side, down stream, of a granite boulder, lay a confused heap of white and peeled sticks crossed and re-crossed in every direction, forming an irregular thatch. A little clay and moss showed here and there between the interstices. The whole mass made a very flat irregular dome resting on the side of the rock, with two horns as it were running into the water and concealing the water galleries, by which the beaver had access to the interior. The long diameter was about twelve feet, the short six feet, and the height above water about three feet. The entire mass resembled a cart load of white peeled sticks thrown down against a rock. The same instinct that had taught them to make the dam, convex side up stream, had here as I said before, taught them to place the dome against the down-stream side of the rock. In both cases to preserve them from the pressure of ice.

We had the grace to spare an inhabited house, but meeting a deserted one, which wonderfully resembled an old barn with its thatch broken, and rafters bleaching in the rain, we cut with our hands and axes through the top. It was composed of a layer of sticks, clay, moss and grasses, very firm and about two feet in thickness. Peeping in we saw a shelf running round the interior which sloped to a central hole at, perhaps, an angle of thirteen, and through this hole we got glimpses of the water, and the arch of the submarine water galleries by which the beaver passed out and in. Here all was desolation and ruin, but in an inhabited house, the sides of the interior are gnawed neatly into line by cutting away the projecting sticks, and lined with grasses and moss. The shelf sloping gently almost to the water's edge, touched by ruin though it was, seemed well fitted for the inmates to rest their head and fore parts upon, whilst their hind paws and tail rest in the water, a favorite position of the beaver. The higher and more interior part of the shelf with its warm lining of grasses made a snug bed. Though we saw none, yet there must be air passages on the land side above the water line (and therefore not used for galleries) to afford air. So real was the air of labor and design wreathed around their dilapidated pile of bleached sticks and mouldy clay, that the speculations one has, half sad, of the old inmates of a deserted house as we wander past the fireless hearthstone, seized us as we floated off. "Got ten dollars out of that house year before last," said James Meuse, bending to the water's edge, as he toiled in shoving our canoe all but high and dry stranded on a carpet of lily pads. Sometimes these domes are seen covered only with clay, and hard frozen, the beavers seemingly caught by the early frosts before finishing their homes with their rough thatch.

Hearne, a most accurate writer, describes these structures as eight feet in thickness, and a large dome constructed of many small ones, or wings set off from the central one, some of which having internal communication. No doubt he is correct, and the high northern latitudes and greater abundance of the beaver, makes the difference between the lowly structures I have endeavoured exactly to describe as seen by myself. Seeing a hundred years have passed since Hearne faithfully wrote, there can be no excuse for modern works, aided by the most beautiful etchings, misleading their readers, as they habitually do, even down to our own times.

ART. X. COMPARATIVE ANATOMY AND PATHOLOGY OF THE HUMAN TEETH. BY A. C. COGSWELL, D. D. S.

(*Read April* 8, 1872.)

TEETH are the prime organs of mastication, so essential for the proper trituration of food both in man as well as animals. In man they have a secondary relation subservient to beauty and speech, while with animals we find them used and adapted for seizing, tearing, dividing, pounding or grinding the food, as well as formidable weapons of offence and defence, aids in locomotion, means of anchorage, instruments for uprooting or cutting down trees, as well as carrying materials for building. Teeth are always intimately related to the food and habits of the animal, and consequently highly interesting to the *physiologist*, important to the *naturalist* in the classification of animals, and as zoological characters, are enhanced, by the durability of their tissues, being often the only remains discoverable in the deposits of former periods of the earth's history. Our purpose is not to go into a strict classification of these organs, but merely to name some facts in relation to the peculiar formation, modes of attachment, and singular growth and appearance in many animals, comparing their density and indestructibility to those of man.

In the Dental system of the fishes we find their number, form, structure, substance, situation, or modes of attachment, present a greater and more striking series of varieties than of any other class of animals. The lancelet, sturgeon, and paddle fish are *edentulous*, until the number vary and are multiplied in many fish, progressively, finding the mouths of many crowded with countless teeth. The moveability of the teeth of some fish is peculiar, as in the shark, and the singular fish called the *angler*—their base being tied by ligaments to the jaw, but they have no power of erecting or depressing the teeth at will. In the wolf fish, "Anarrhicas lupus," the powerful crushing teeth, made blunt by use, with the roof of the mouth almost covered, presents a subject of interest to the anatomist. The muscles of these fish have enormous power, from the constant exercise in crushing lobsters, whelks and other shell fish on which they live.

The system of shedding and renewing is peculiar to the fish, also in the Gangetic Crocodile called "Garrhiel," if at any time one of the teeth be removed, it will be found hollow at its base, and partly absorbed, presenting the appearance of a child's deciduous tooth, when partly absorbed, and at the base of this, a new germ of the successive tooth. The rodents also present this wonderful development of tooth structure, where the canine teeth are wanting. The incisors two in number in each jaw are always growing, never ceasing, while the animal lives, requiring constant exercise and abrasion to maintain the normal form, and serviceable proportions, as with the rat and rabbit.

If in either of these an upper incisor is lost, or distorted union of a broken jaw, rendering articulation imperfect, the incisors continue to grow, until they project like the tusks of an elephant, and following their curve the points sometimes return to their head, penetrate the skull, and cause death. I saw the skull of a beaver in the Philadelphia Dental College Museum, the tooth of which presented the above appearance, having grown out of all proportion, causing no doubt the death of the animal.

Higher in the scale we find in the genus Elephas the larger and complex molars, never more than one or two partially in place and use on each side, at any given time, for this progress of formation and destruction, of shedding and replacement is constantly going on, the molars or grinders succeeding one another from *behind* forward.

Another peculiar and complex condition of the dental system is presented by the *poisonous* serpents, in which teeth are associated with the tube or duct of a poison-bag and gland.

These teeth are called *poison-fangs;* they are confined to the upper maxillary, only one (if more in number) contain the poison fang, the tooth presents a curved appearance, on its sides are grooves connecting with the poison-bag, and on the animal seizing its prey the poison is forced into the wound along the groove in the tooth, causing death as soon as the poison is diffused through the system by absorption.

Beside means of offence and defence in some animals the long *tusks* serve as weapons of attack, and as instruments in aid of climbing the floes and hummocks of ice, like the walrus, while the beaver use their teeth also for the purpose of cutting down trees and carrying them in their teeth to build their dams. (Beautifully illustrated by Dr. Gilpin at the last Institute meeting.) The teeth of carnivora and granivora, or such animals as live on flesh, and those who subsist on grain or a mixed diet, the organs of mastication assist to make the distinction, not only in their number but in their density and mode of articulation, having special forms for special uses.

The *names* also indicate their use as in man: the front teeth from being commonly adapted to effect the first coarse division of the food, have been called cutters or incisors,—the back teeth which complete its comminution, grinders or molars, and the large conical teeth situated behind the incisors, nearer the masseter muscle are called the canine, or holders, tearers, or laniaries, such as we find in the dog and that class of animals; while the two between the laniaries and the first molars are the bicuspids or double cuspids. In the use of the teeth we find a difference between the granivorous and carnivorous animals: while with flesh eating animals or carnivorous there is only an up and down motion of the jaw, with well developed cuspid teeth, while with granivorous animals a lateral motion, and a *deficiency* of the cuspid teeth (in many cases) as in the horse, sheep, cow, &c.

In *man* the jaws are short and the crowns of the teeth are of *equal* length; no *vacant* spaces in the dental series of either jaw, and the teeth derive their *additional fixity* by their close and mutual pressure; and from these facts, and others, finding also the density of the teeth *harder* than all others, present in this aspect the *highest order of human organization*. The *structure* of the teeth vary from the lowest class to the highest, taking the fish (as the sperm whale) they have no true enamel, while the elephant, walrus, narwhal, consists of *modified dentive* called *ivory*. In the hippopotamus it is said the substance is hard enough to strike fire. This is not an uncommon occurrence in excavating the human tooth, as I have often seen the steel instrument coming suddenly in contact with the enamel, cause a spark of fire to fly off like steel and flint coming in contact. Comparative analysis of the enamel of the teeth of the pike, ox, and lion with those of *man* give a large percentage in favor of the latter, the phosphate of lime being greatly in advance of the other.

	Man.	Lion.	Pike.	Ox.
Dentine—	66.72	60.03	.....	59.57
Enamel—	89.82	83.33	63.98	81.86

In man we find a difference in favor $5\frac{67}{100}$ of the phosphate of lime or enamel over the lion, while many teeth are composed only of dentine and cement, like the great sperm whale, the cement taking the place of enamel. The human tooth at first sight appears to be composed only of dentine and enamel, but their *crowns* from the gums are covered with enamel, while the roots are covered with a cement or *crusta petrosa.* The internal structure of the teeth are *nourished* and *supplied* (of man) from the principal nerves running through the central portion of the teeth, thus we have a longitudinal section of a cuspid tooth with various modifications, *tooth structure*, *nerve* and its *filaments.* The three different substances so readily seen in the chart are these three disposed according to the *purposes* required of them.

First, we have the cementum or crusta petrosa; second, the dentine, (known as ivory in the tusk of the elephant), and third, *enamel.*

The first, cementum or crusta petrosa, corresponds in most especial particulars with bone, possessing its characteristic *lacunæ* or small cavities, and being traversed by small medullary canals; this is the first covering of the young teeth, and covers the *fang* of the tooth which enters the alveolar process of the jaw.

The dentine or ivory consists of a firmer substance, in which *inorganic* or mineral matter predominates *less* than the enamel. This is traversed by a vast number of *very fine tubuli*, (as seen on the chart,) which commence at the pulp cavity and radiate toward the surface.

The size of these are immeasurably small, so much so that they cannot receive blood, but no doubt like canaliculi of bone, imbibe *fluid* from the pulp cavity, thus aiding in the nutrition of the tooth. These *tubuli* when deprived of enamel covering become *highly sensitive*, and are the small *telegraph wires*, giving warning of approaching danger to the pulp and nerve, which is the *life* of the tooth.

The third portion is the enamel composed of *solid prisms* of fibres about 15600ths of an inch in diameter, arranged side by side, closely adherent to each other; their length corresponds with the thickness of the layer which they form; these two surfaces present the ends of the prism usually more or less hexagonal, and in its perfect state contains an *extremely minute quantity* of *animal* matter.

The pulp cavity is in the centre of the tooth; this contains the *nerves* and blood vessels, branching off from the chamber of the tooth, supplying each root or fang, and thus connecting through the apex or apicial foramen, (almost as fine as the point of a fine cambric needle,) with the facial nerve receive their supply, which give the teeth life and sensation, and enables these organs when wounded or diseased often times to take on a healthy action, and forming on which is frequently found secondary dentine, properly called osteo dentine, or a new growth of tooth structure, as may sometimes be found on the grinding surface of the superior or inferior central incisors, where the articulation is such as to have caused the direct contact of both upper and under, on the cutting edges, and by rapid wearing away of the dentine, after the loss of the enamel, endangering encroachment upon the pulp and nerve; and for the protection of this a wise provision, if sufficient time be given, is the formation of this secondary dentine.

This growth of osteo-dentine is well illustrated by Professor Owen in speaking of the skull and teeth of the elephant, as follows:

"The musket-balls and other substances or foreign bodies which are occasionally found in ivory, are immediately surrounded by osteodentine in greater or less quantity. It has been a matter of wonder often how such bodies should become completely imbedded in the substance of the tusk, sometimes without any visible aperture, or how leaden bullets may have become lodged in the solid centre of a very large tusk without having been flattened. The explanation is as follows: A musket ball, aimed at the head of an elephant, may penetrate the thin bony socket and the thinner ivory parities of the wide conical pulp-cavity, occupying the inserted base of the tusk;

if the projectile force be there spent, the ball will gravitate to the opposite and lower side of the pulp cavity.

"The presence of the foreign body exciting inflammation of the pulp, an irregular course of calcification ensues, which results in the deposition around the ball of a certain thickness of osteo-dentine. The pulp then resuming its healthy state and functions, coats the surface of the osteo-dentine inclosing the ball, together with the rest of the conical cavity into which the mass projects, with layers of normal ivory.

"The portions of the cement-forming capsule surrounding the base of the tusk, and the part of the pulp which were perforated by the ball in its passage, are soon replaced by the active reparative power of these highly vascular bodies.

"The hole formed by the ball in the base of the tusk is then more or less completely filled up by a thick coat of cement from without and of osteo-dentine from within.

"By the continued progress of growth, the ball so inclosed is carried forward, in the course indicated toward the middle of the tooth. Should the ball have penetrated the base of the tusk of a young elephant, it may be carried forward by the uninterrupted growth and wear of the tusk, until that base has become the apex, and be finally exposed and discharged by the continual abrasion to which the apex of the tooth is subjected."

To illustrate this more fully if a molar tooth with a superficial cavity, highly sensitive from inflamed tubuli, be carefully filled with a suitable material, preferring that least acted upon by thermal change, and allow the same to remain three months at least, it will be found on removal that the sensibility and pain no longer exists, and in excavating and carefully examining a firm hard layer of *new dentine* will be found covering and protecting what was almost too sensitive and painful to bear, this may be considered as *renewing* of *tooth structure*, and a supply of waste material as well as protection against unnatural abrasion.

In the composition of the teeth, we have *organic* and *inorganic* or earthy matter, the density varying chiefly as the earthy matter contained in each.

Chemical analyses give the following as one result taking the incisors of man. In one hundred parts—

	Cementum.	Dentine.	Enamel.
Organic Matter—	29.27	28.70	3.59
Earthy Matter—	70.73	71.30	96.41
	100.00	100.00	100.00

These differ, however, as to the result occasionally, according to the organic constituents, and as the teeth have been divided into six degrees of density in man, this difference is owing whollv to the presence of earthy matter. Thus in children who have been sickly and delicate, fed on improper unwholesome diet, a deficiency of the bone forming material given in the food, and in those who also inherit weak animal constitutions, from either or both parents, may be found teeth of the poorest organization, chemically deficient of the average earthly matter, the enamel varying little above dentine, enamel roots imperfectly formed, and a chalky calcareous appearance readily acted upon by the vitiated saliva of the mouth and chemical acids; these vehicles dissolve and destroy the organic material, leaving only the gelatinous portions of the teeth to gradually waste away: whereas, if the enamel was perfectly formed, it would resist these chemical changes, and subserve the purpose of the Creator for all the wants of our physical organization.

In comparing in ordinary bone the earthy matter, inorganic, or phosphate of lime so familiarly known as bone earth, we find it constitutes only 54 parts of the 100, while in the enamel of the human teeth, it is nearly 90 in the 100 parts, the enamel being almost a mineral in substance, having only $3\frac{59}{100}$ parts of animal matter in the 100.

If for experiment we collect the several classes of human teeth from that of the lowest per centage of inorganic material, calling that No. 6, and ranging up to No. 1 the most perfect and dense enamel 96 per cent of lime, place these in sulphuric acid and water, equal parts, the result will prove after 24 hours which class of teeth will resist the acid the longest, and in proportion to the density of the enamel, so the dissolving of lime salts, leaving as the result, the entire loss of the enamel, forming a white sediment, while only the skeleton or organic remains of the teeth are left. No. 6 of the lowest structure is deprived of its enamel; 1st, owing to its deficiency, proving that the loss of these organs vary from two reasons, viz: from the action of the chemical agents upon low formed teeth. 2nd, the deficiency of earthy constituents in the early formation of these organs. While the teeth of animals are made to subserve their purpose during life, by the peculiar process of shedding and replacement, well may we ask why it is that those of the highest class of organization in man should be so early lost; that premature decay causes so many edentulous males and females before the age of 20, and often as early as 12 and 18, the period of full bloom and vigor, when all the physical powers require to be in the fullest enjoyment of health, and activity? But it is a fact that among the people of British North America, and especially in the United States, where scrofulous diseases are transmissable, the offspring of such parents invariably suffer from their injurious influences, and if this taint passes through the blood it is not to be wondered that thousands fill up the bills of mortality of that fatal disease, "scrofulous consumption;" and if while those who live are only improperly fed, have little outdoor exercise, excessive excitement, irregular rest, and are at best almost *walking skeletons*, what can be expected otherwise than an imperfect organization of every part of the human body; while not only among the higher classes and wealthier, but among the lowliest, many partake of the deleterious domestic compounds and luxuries, which contain at best slight nourishment, which, if suitable for invalids, are entirely unfit for those who are already possessed of weak and delicate constitutions. Under these circumstances what can we expect, with our hothouse, modern-improved mode of living, breathing the in-door carbonized and sulphuretted atmosphere, in place of the oxygenated atmosphere, the one only gift God has given to stimulate and purify our blood? It is not at all strange then that the constant abuse and violation of nature's laws should so rapidly fix upon us "all the ills that flesh is heir to." Therefore the loss of the human teeth, like the worn out videttes of a beaten army, give early tokens of functional or organic disease. It is the immutable principle of nature to proceed in every step of her operations by degrees; and finding causes for defects, let us endeavour to remedy if possible these deficiencies. How true are the words of Shakespeare:—

> "If all design begun on earth below
> Fail in the promised largeness, checks and disorders,
> Grow in our veins of action higher reared,
> As knots—by the conflux of meeting sap—
> Infect the sound pine and divert his grain,
> Tortive and errant, from his course of growth."

Is there a possibility of assisting in any way to overcome this deficiency in the physical organization? If so is it not the duty of every parent and guardian to look at natural causes and effects? If the soil is not supplied with proper fertilizers it *cannot* yield its full return. So with the animal economy: it avails itself of the nutrition required by the peculiar vital principle, acting within and upon each constitution. It appropriates no more and no less than the vital principle stimulating the organs will permit, and, if an insufficiency of *bone forming material* be not taken into the system by the food, *imperfect developement must be and is the result* in the human organization.

We will also find that so long as the constitutions of men differ from each other, so will there be the same great variety in the physical character and pathological condition of the dentive organs. The blood which is the fluid source from which the teeth, bones, tendons, muscles, nerves, life, hair, membranes, in fact the whole organized body are metamorphosed, so wonderfully adapted for each that the mind fails to comprehend how these arrangements are performed. Still we recognize the fact that blood is the life of man, pure or impure.

It has been a subject of some discussion for some time, whether the administering of phosphates in various forms as extracts, acts in the same way upon the physical organization as food containing the same.

We all will admit, however, it is far preferable to take food as medicine when made palatable than in some of the compounds often administered, either homeopathic or allopathic. While many may be palatable, still the fact of one being *food* and the other *medicine*, acts at least upon the *imagination* if not upon the *body*. The insufficiency of bone forming material to children is the cause, no doubt, why in so many cases we find such imperfect development of the teeth, as well as the bones, of the youth in these days compared to giants in their days, and whose teeth, 'tis said, *never were diseased*, and the enamel of which, as I shall shortly give several instances recorded, had remained centuries in a perfect state.

The substances most essential as bone producing in the young, we shall quote from Carpenter's Physiology :—

"The phos. of lime is contained more or less abundantly, in most articles generally used as food, and where they are deficient or *removed by any means*, the animal suffers in consequence, if not supplied in any other way; contained largely in the seeds of many plants especially the grasses, also in flour, oatmeal, corn, &c. Now if this *bone earth*, so often called, be removed by sieving, as is the case in wheat flour and many other cereal grains, what is to supply the system in place of it? This property *must* be in the blood to feed the growing parts, or else a sure deficiency of the enamel. The fact that insufficient coarse unbolted cereals are now consumed, that the outside of wheat, oats and other grains ground and used as food has been thrown away is, no doubt, one reason why the present generation have so imperfectly formed teeth."

Professor Johnson's practical observations on the above gives in 1000 lbs of whole grain, 170 lbs bone and salt.

Fine flour,	60 "	"	"
Bran	700 "	"	"

Here is a difference between fine flour, ordinarily used for domestic purposes of 530 lbs more in 1000 lbs of bone material, also shewing the whole grain is one half more. A Mr. Betz says, the weight of the bran or outer coating would, in the common superfine flour, constitute the offal to be about 5½ lbs. to the barrel of flour, while the ordinary weight of offal is from 65 to 70 lbs to each barrel of flour. Now if we estimate the earthy constituents to be ⅗ of the offal of bran we must consider there is an actual loss at least, in every barrel of fine flour used, of 40 lbs. Now to estimate a child's consuming say a half barrel, annually, of flour, we find it has been deprived of 20 lbs. of the earthy substance required to form the bones and teeth.

What better proof of the value and perfect formation of the bone and teeth do we require than among Scotchmen. A fact worth remembering to those on this continent, is, that the Scotch oatmeal *contains the bran*, while the oatmeal used in England is deprived of it, and as for the Americans what little *they do use* requires to be well sifted, well buttered, and then taken in *homeopathic doses*. The Scotchman thought it better to bless the Duke of Argyle than to resort to professional skill to remedy defects.

The *indestructibility* of the enamel of human teeth (compared with all others) if *properly formed*, except by the action of disease during life, or from the force of fire when the body has been burned, may be substantiated from the following: Dr. William Buckland the great geologist, speaks of the teeth found in the cave at Kirkdale, Yorkshire, in 1821, among which were those of the elephant, rhinoceros, hippopotamus, bear, tiger, hyena, and sixteen other mammalia, the enamel of the teeth of these lower animals, were almost always in bad condition, while the human teeth found were the reverse. Dr. Buckland believes that if ever an *antediluvian* man were discovered, the fact of his being man would be ascertained by his teeth. Archdeacon Tache in a communication to the London Times quotes a passage from a friend and brother clergyman in Wiltshire as follows:—

"I have in my collection a part of a jaw bone, and two teeth in situ, which belonged to one of the soldiers of the Tenth Legion, and a tooth that once did good service among the molars of our good King Alfred's stalwart warriors, in that time when he finally routed the Danes between 849 and 900, some 900 years ago at least." The soldier was not one who believed in *carefully preserving* these organs, like an Irish woman who after having had a molar removed and on being anxious to take it with her, was asked by the dentist why she was so careful in preserving it? answered, "*Sure*, sir, do you think I want to be hunting round resurrection day for my teeth."

The teeth of mummies generally have been found in a perfect state. Mr. Pettigrew, librarian to His Royal Highness the Duke of Sussex, and a celebrated surgeon, famous for the great number of Egyptian mummies he had unrolled, admired the perfect preservation of the enamel, and found the teeth invariably in an excellent condition, the discoloration from the vehicles used in embalming, generally disappears on exposure to the air. Shelden McKenzie, D. C. L. of Philadelphia, in a paper read before the Philadelphia Odontographical Society, relates the following among his travels: "Near the harbour of Holyhead (in Wales) and within view of the Stack lighthouse, is an overhanging cliff called Capal-na-Carrig, which in the Celtic language means the Chapel on the Rock. Tradition reports that a Druidical temple once stood on or near this precipice. It is very much exposed to the weather, and portions of the soil fall into the sea frequently; after a storm visiting Holyhead in 1837 I found on the summit of this cliff an immense number of human bones, protruding through the sandy soil, and at almost every step, with my walking stick, exposed a skull or some large bones. The bodies lay north and south, and not east and west, according to the christian practice of placing them. From what could be ascertained, at some very remote period there had been a battle on the island, and the dead had been buried where I found the bones. From these I collected several hundred human teeth in a perfect state of preservation."

The disinterment of the remains of William Rufus, who was shot by Walter Tyrrel, is another instance of the indestructibility of the enamel of the human teeth—from his coffin were taken nine teeth, perfect, having been entombed 768 years.

We will glance briefly at some of the principal causes of the loss of the human teeth, both in those imperfectly formed, as well as those of perfect structure.

Among the causes of premature loss of the human teeth, next to the chemical action of the vitiated condition of the saliva, is the presence of a foreign body attacking generally the six under front teeth, and the superior molars on each side. This deposit is *salivary calculus* or tartar; a low form of animalculæ form gradually, and after years of accumulation, force the gums away from these teeth, produce inflammation, suppuration, and ultimate looseness, and entire displacement and loss.

Thorough cleanliness and the free use of coarse food and meats, acting on and around the necks of the organs, would prevent this accumulation. No better example need be given than in examining the mouth of any one who from diseased organs on one side of the mouth, use only the opposite, allowing the teeth not used to become frequently entirely encrusted and covered with this substance. Among the vegetarians of Japan it is said this disease is very marked, as the food they chiefly subsist on is rice, beans, sweet potatoes; but since foreigners have resided there the natives eat meat. In the streets of the capital, there are numerous stands kept by the wayside merchants, who supply the passers by with this new foreign notion called beef-stew. Dr. Elliott, who resides there, states that it is rare to find an elderly person with teeth, and as for the daughters of Japan the practice and horrible custom of blacking the teeth, after marriage, destroys their beauty.

In the study of the pathological condition of the teeth, we are also to discover if possible, wherein the harmony of demand and supply has been interfered with, causing a premature loss of these organs. In a healthy and normal condition of the human system, we find if proper food be taken into the system, the teeth will not only be perfectly formed, but healthily preserved, provided ordinary care and cleanliness be exercised.

Cleanliness cannot be too largely written in letters of gold, not only to the young, but to those of all ages. For in the carnivora we discover that not only the foul mucous covering of the tongue, but the tartar of the teeth, consists of the *dead* remains of millions of infusorial animalculæ. Leuenhoek long ago discovered this foul mucous, while Mandel made known the chemical decomposition found in the human mouth, so called *tartar*. By dissolving a portion of this in water and placing it under a microscope, the delicate scales are observable.

If these organs which the Creator has given to all, so useful and necessary, and which should be as hard as adamant, are so readily and frequently lost, is there not something radically wrong in the present system of living, and the want of the proper care of the teeth?

It is most especially deplorable among the females of this country, and in fact continent, that descendants of European parents, should be so afflicted with caries of the teeth and the decay of parts formed of substances which enter into the composition of some of our hardest minerals. Many females, ere they attain a marriageable age, are obliged to resort to professional skill, replacing the natural with the mineral, or enamel of the artists' formation. This ought not to be, God made all mankind alike, in no portion of the earth are nations found who lose their hands, feet, or tongue, and no cause why the inhabitants should lose their teeth. It is not so in olden countries, from whence the progenitors of the present race have come, nor is it so in the West India Islands. So excellent is the structure of the teeth in savage nations, that some tribes in Africa file all the front teeth, so that they shall be separated and form sharp points, the better to tear the uncooked animal food. The ancient Welsh took better care of their teeth by cleansing, than many in our day of civilization. They used as a primitive way a stick of green hazel to rub the teeth, and abstained particularly from *hot* food of every kind, and in the fifteenth century Richard the Third granted a pension to one Matthew Flint for the purpose of caring for the teeth of the poor of London.

Art and professional skill combined may assist to restore what the ravages of disease may have destroyed, but unless constitutional weakness of these organs be overcome, the deficiency supplied in early life by the lime salts or earthy constituents, care and cleanliness in after years, it will be impossible for the rising generation to be less liable to the loss of the teeth, than those of the present.

Among the remote causes also of dental decay, I am firmly of the opinion from a large number of observations, that the present condition of the teeth of the father or mother at the moment of conception, will nearly always be represented to a greater or less extent in the offspring, and the teeth of the child during gestation are affected for good or evil by the degrees of health possessed by the dental organs of the mother; therefore if such be the case, the greater necessity of administering more of those nutritive elements which give strength to the *osseous* system, and perfect calcification to the teeth.

That parents should insist on it that their children not only eat nourishing food, but also that it shall be *hard*, requiring considerable effort in mastication. If a muscle suffers for the want of action, requiring its fibres to be put in daily use, so too will the teeth—they require work. The mastication of hard substances gives the periosteum of the roots a healthy stimulus, consequently a healthy nutrition follows.

One more fact and I have done. Dental Irregularities are certainly more frequently among children of the present day than formerly; this no doubt is also hereditary, to some extent, the parents having lost in early years the molar teeth that first erupted, called the six year olders. These are the first to be removed. In examining the mouths of 100 patients over 25 years of age, more than 75 per cent had lost these same teeth in early life. The principal teeth removed from children are these same large molar teeth, the reasons given when asked why allowed to go so far, is invariably that parents are under the impression that these are the first teeth, and if lost will be renewed, hence when these are lost at so early a period of life, the alveolan ridge contracts, and the arch becoming narrow prevents the proper development and articulation of the remainder, producing as the result crowded dentures, and surely early decay. This from my observations I find more frequently in the city than in the country, this may be also owing to the more luxurious habit of city children over those living in the country.

It is said of the celebrated Æsop, who gave us so many fables, that his master on going out with some friends on a hunting excursion, gave him directions to prepare dinner of the very *best* his larder afforded. On returning from the chase a dinner was found served up entirely of *tongue*.

On another occasion he was ordered to prepare a dinner of the *worst* his master's larder afforded. And again also a dinner was served entirely of tongue. Æsop being called upon for an explanation of the singular transaction, said that he had obeyed his master's injunction in the first instance, inasmuch as the tongue was designed for universal application, and when properly controlled and directed it was capable of conferring the greatest amount of good, and therefore was the best thing in the world. On the other hand, when not controlled and directed aright, it was susceptible of becoming an instrument for the accomplishment of the greatest amount of evil, and was therefore the *worst* thing in the world.

So in conclusion, the teeth like Æsop's tongues, occupying the same tenement, if *properly cared* for and *directed* aright, so that they be neither *irregular* or *defective*, may carry us to that period of life which Shakespeare calls the *seventh age*—Sans teeth, sans eyes, sans taste, sans every thing; but when not cared for and directed aright become instruments of slow torture and agonizing pain, until patience ceases to be a virtue, one by one they are removed or prematurely lost, suddenly transferring youth into old age.

I have endeavoured to show, from these few imperfect observations, that special agents affect these organs both in their construction as well as destruction; that a remedial treatment is desirable and possible; that the remedy lies to a great extent within the power of each individual; that the disease may be prevented, a healthy condition preserved, life prolonged, and instead of premature loss, they will continue as the Creator designed they should, co-extensive with other members of the body, endowed ordinarily with the same degree of perfection as other constituents which make up the human physical organization.

Art. XI. On the Geology of the Iron Deposits of Pictou County. By Rev. D. Honeyman, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

(*Read April* 8, 1872.)

ABSTRACT:

In the Appendix to Reports on the Pictou Coal Field, *Report of Progress of the Canadian Survey from* 1866 *to* 1869, *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 Coal Field. Of the age of their formation I cannot speak with certainty, but it is probably Upper Silurian. The rocks consist of quartzites 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."

I would observe that the fossiliferous rocks referred to are of the same age as the rocks of McLellan's Mountain, and that the fossils collected by Mr. D. Fraser, and the iron deposits, belong to two different series of rocks, and that the fossils are of undoubted Upper Silurian, and the iron deposits of Middle Silurian age.

I would here observe that the distinction I make is in accordance with the division of the Silurian system made by the Geological Survey of Canada. In their Geological Map this system is divided into Lower, Middle and Upper. It also agrees with that made by Professor Ramsay, Director of the H. M. Geological Survey. He divides the system into Lower, Intermediate and Upper.—Vide Memoir on the Geology of Wales.

The collection referred to, which I have examined, is from the upper part of the W. side of Anticlinal series, No. 1. It includes a considerable number of the *Lower Helderberg* fossils contained in my list, and also a few of the *Niagara* fossils of the same series. *Vide Transactions*, 1870–71, page 8—Upper Silurian. The Specular iron ore referred to lies in the south side of my Anticlinal series No. 4, in the *Metamorphic Clinton*, so that it comes to be of Middle or Intermediate Silurian age. I have elsewhere shown that this is the age of the strata containing the Limonite, or Brown Hematite which lies in the lower part of series No. 1, *i. e.* the series producing Mr. Fraser's fossils.

Mr. Hartley by a singular process of reasoning, infers the probable Upper Silurian age of the Limonite from the probable Upper Silurian age of the Specular ore referred to, *vide Appendix.* Mr. Hartley *in the quotation*, evidently regards the lithological dissimilarity existing between the Specular iron bearing rocks and the supposed Devonian rocks of McLellan's Mountain and Waters' Hill as the result of difference of geological age.

On palæontological and stratigraphical grounds I have proved that all are of Middle Silurian age. Waters' Hill being the only possible exception. It is not difficult to account for the acknowledged lithological dissimilarity referred to.

On comparing the strata of *Clinton* age at Arisaig with those at Barney's River and French River, Merigomish, where the rocks in both cases are fossiliferous and nearly in an unaltered condition, we find great difference in lithological character. My (B) or Lower Clinton at Arisaig consists principally of homogeneous shales of black colour, leading people to infer the existence of coal. The same is their character at Sutherland's River. At Merigomish the same are greenish and soft.

At Arisaig (B and B′) Lower and Upper Clinton are so different in their lithological aspect and palæontology, that I was disposed to separate them, but fortunately I discovered in (B) a nodule containing Graptolithus Clintonensis, *Hall*, the characteristic fossil of (B′), and consequently I designated the two respectively as Lower and Upper Clinton. At Merigomish (B & B′) are lithologically similar, and are only distinguishable by their fossils, consequently we have reason to expect lithological diversity in the two sets of strata when metamorphosed.

This is precisely what Mr. Hartley observed at East River and McLellan's Mountain, and what he was unconsciously led to misinterpret.

The metamorphosed black slates containing the Specular iron ore have by their colour, led to a search for coal, as at Arisaig, while other appearances at East River, Waters' Hill, and McLellan's Mountain have some correspondence with the other lithological aspect of unaltered and fossiliferous strata of Clinton age.

ART. XII. BRIEF NOTES ON THE FLORA OF NOVA SCOTIA. PART I. BY HENRY HOW, D. C. L., *Professor of Chemistry and Natural History, University of King's College, Windsor, N. S.*

(*Read April* 8, 1872.)

THE botanical notices given by Professor Lawson at the last meeting of the Institute, reminded me that I have become acquainted with some facts respecting plants in different parts of the Province which should be placed on record; and I now proceed to offer notices of some of them to the members of the Institute.

1. A Fern hitherto unknown in the Dominion. At the meeting in question, Prof. Lawson announced the discovery of *Lastrea fragrans* at Cape Canso by Rev. E. H. Ball, and mentioned that this is an interesting addition to the list of hitherto known Nova Scotia ferns. The plant next to this in Gray's Manual of the Botany of Northern U. S. (second edition), viz., *Aspidium aculeatum*, I met with in 1870 in a wood on Marble Mountain, Bras d'Or Lake, Cape Breton, about 600 feet above the lake. I conclude that this fern has not as yet been mentioned as found in the Dominion, from its not being referred to in Prof. Lawson's Synopsis of Canadian Ferns and Filicoid Plants published in Edin. New Phil. Journal 1864, or in any subsequent memoir I have seen. Gray states (*loc. cit.*) that it is found on the mountains of New Hampshire, Vermont, N. New York and northward. It is a common fern in Great Britain, where it is now called *Polystichum aculeatum*. The mounted specimen, one of the two originally gathered by myself, I send to illustrate this note, is for subsequent presentation to the Provincial Museum as an addition to the Herbarium of Nova Scotia Plants procured from me by the Provincial Commissioners for the Paris Exposition of 1867.

2. *Anagallis arvensis*, Linn. This pretty little plant, well known in England as Poor Man's Weather Glass and Common Pimpernel, is European, but naturalized in America. I found it flowering in profusion near the Schoolhouse in Digby in 1868. I have not seen it elsewhere in the Province.

3. Hornbeam or Iron Wood. In 1868 a tree was pointed out to me close to Moose River, Annapolis county, near Clementsport, as almost the only one remaining of many "hornbeam-trees" formerly existing in the vicinity. The two species *Carpinus*, L., and *Ostrya*, Michel, are included under the term "hornbeam," but I cannot say which of these the tree belonged to. So far as I remember it was 30 or 40 feet high at least, so that its size would be that of the latter, but its growing on the side of a stream would accord better with the recorded habit of the former.

4. New station for *Osmorhiza brevistytis*, D. C. In the Herbarium above alluded to is a specimen of this plant from East Mountain, Onslow, Colchester county. I have since seen it growing on Marble Mountain, C. B., and at Redden's, near the bridge at Kentville, King's county.

5. *Actæa alba.* In Prof. Lawson's valuable Monograph of the Ranunculaceæ of the Dominion of Canada, and adjacent parts of British America, read before the Institute in Dec. 1869, it is mentioned that *Actæa rubra* is widely spread throughout the whole Dominion, but *A. alba* is south western. Gray states that this variety is more common southward, extending to Virginia and Kentucky. It grows at three places in this vicinity, viz., Windsor Falls, Butler's Mountain, and Nesbit's Island.

6. Potentillas at Windsor and westward. At Windsor we have *P. Norvegica*, *P. Canadensis*, and *P tridentata* in abundance, and more sparingly *P. anserina*, and *P. argentea*; this last I have only seen at one spot, but it is common westward, viz: at Kentville and Coldbrook, King's county, and on the road as far as Digby. *P. anserina* I found at the head of Bear River, Digby county.

7. *Dalibarda repens.* The Herbarium spoken of above contains a specimen of this plant from Wilmot, Annapolis county. In 1868 I saw the plant at Jauvet Comeau's, Bloomfield, Digby county.

8. *Nasturtium officinale.* Water Cress. This plant is mentioned by Gray as found in the United States "in brooks and ditches, rare, escaped from cultivation, naturalized from Europe." Last year I learned that it is plentiful in two brooks near the Three

Mile Plains, between Windsor (town) and Newport. Buckets of it were brought to an English colleague and myself, both of us being glad to renew our acquaintance with our pungent favorite of former days.

9. *Moneses uniflora* is mentioned in Prof. Lawson's elaborate Monograph of the Ericaceæ of the Dominion and Adjacent Parts of British America, (read before the Institute, 1871) as having been found at Mount Uniacke. I have met with it near Windsor and at Wilmot. We have here also *Pyrola elliptica*, and *P. secunda*. *P. rotundifolia* I have got near the Rectory at Wilmot.

10. *Echium vulgare*. Blue Weed. This European plant I have got in a field of Mr. McLean's, about 4 miles from New Glasgow, on the road to Merigonish, Pictou county. I was told that it grows only in that spot.

11. Of European plants observed near Sydney Mines, Cape Breton, may be mentioned *Urtica urens* which was said to have been introduced a little before 1859 when I saw it, *Lepidium ruderale* and *Euphrasia officinalis*.

12. *Viola rotundifolia*. This pretty plant, the one yellow violet, of which there is a specimen in the Herbarium before mentioned, I have only seen growing at the locality where that specimen was got, viz: at the Manganese Mine, in the woods at Teny Cape, Hants county.

Art. XIII. On the Meteorology of Halifax. By Frederick Allison, Esq.

(*Read May* 8, 1872.)

My paper this evening opens with a brief sketch of the Meteorology of Halifax for 1871. The accompanying table of figures is rather more extended than in previous years; since I have now obtained accurate observations of most elements for nine years, and can therefore venture to calculate normals with a fair guarantee of precision. Certainly a more lengthy series will give results more accurate, and perhaps slightly, varying from these; but we may at present rely upon these deviations as closely approximating to the truth.

As the tables are before you I do not generally recapitulate the figures, but comment upon the monthly and yearly characteristics.

January, 1871, was slightly deficient in heat, with a maximum and minimum temperature both low, the latter—13°.7—being very seldom reached in Halifax. The month having been cold and dry, we naturally had a high mean barometer, and the extraordinary height of 30.643 was attained. N. W. wind succumbed to W. N. W., and the mean velocity was very nearly 12 miles per hour. Sleighing was confined to 14 days.

February, usually milder than January, was last year slightly colder, and the maximum remained low. We had no such cold days, however, in February as in January. Mean pressure declined considerably, and the relative humidity was much less. Though some falls of both rain and snow were heavy, the month had a fair share of brightness; wind direction remaining the same, and velocity almost identical. Sleighing on 17 days.

March became very mild, and the thermometer never marked below 16.2. Mean pressure was higher than normal, and did not fall to 29 inches. Rain exceeded its normal by 25 per cent, and there were but 2 days sleighing. Prevalent wind veered to N. W., with a speed of 12.29 per hour.

April on the contrary was cold and backward, with low maximum; and a barometer mean below its normal; with excess of N. wind and great velocity. Precipitation was much as usual, and we had one day of sleighing.

The characteristics of May might serve as a standard for that month, with the exception of the great heat at its close, when the thermometer marked 87°.2. This, however, did not bring the temperature quite up to the normal.

June was a very cool month, but exempt from frost. Its pressure was normal, and amount of cloud as usual. The peculiar direction of prevalent winds is worth noting, although the same S. E. triumphed in 1869. Mean velocity was 7.30 per hour. Wet and dry days were in their customary proportion.

July was also below its normal temperature, and slightly above its normal pressure. This month was cloudy and rather moist; with S. W. winds, the mean velocity of which dropped to the lowest figure 4.87 per hour.

The temperature of August scarcely varied from that of last month. The normal heat of these months is also very close, August being a little the cooler. But one thousandth of an inch separated their pressures, and the precipitation was very nearly the same. Wind, however, got up in August as far as N. W., and the mean of speed slightly increased.

September was still cooler, relatively to its proper temperature, but as yet no frost. Mean pressure was rising gradually. The month had a fair amount of rain, but many bright days, and was generally fine, without a gale. Winds prevailed from W. N. W., and reached 8.46 miles as their average speed.

October was comparatively the mildest month since March—28°.3 being its minimum. Mean pressure was much the same as in September. There was a deficiency of rain, and no snow. S. W. winds generally; and an average velocity of 9.99 per hour. The gale of the 12th deserves a separate notice.

No month last year was so abnormal as November. It was very cold: the mean being more than 5 degrees below nine Novembers; and thermometer falling to 8°.2. The barometer stood low; on one day touching 28.905. N. W. winds prevailed, and their speed was frequently high, attaining a mean of 15.39 miles per hour. Rain was light, but nearly compensated by the excess of snow, of which we had 10 inches, or twice the normal fall.

December remained cold, with a higher barometer, and 25 inches of snow, while but half the usual rain fall was measured. Wind returned to W. N. W., and this last month was again more quiet, giving an average velocity of 9.69 per hour.

Summarizing 1871, we find a cold year—mean temperature being 41°.94 against a nine years normal of 43°.18. March and October alone surpassed their normals in this element. Greatest heat was attained in May, and least noted in January. The range for the year was 100°.9. This is decidedly wider than usual.

The mean amount of sky obscured was 6.0, which corresponds exactly with the mean of 5 consecutive years.

W. N. W. winds exceeded any other, with an average speed of 10.10 miles per hour. The rain fall—41.31 inches—was slightly deficient; but snow, of which we had 97.3 inches in its new fallen condition, exceeded its normal by 22.1 inches. The total precipitation, measuring rain and melted snow, was 51.14 inches. Of days completely dry we had 220—average being 206.

I observed 54 auroras,—26 gales,—57 fogs,—88 dews,—43 hoar frosts,—6 thunders,—7 lightnings,—3 hails,—7 rainbows,—10 lunar halos,—15 lunar coronæ,—1 solar halo; and on 48 days only had we sleighing.

I will now take up the second branch of these meteorological notes:

I propose this evening to examine a few of the popular beliefs and sayings concerning the weather, and to endeavour to show how far these may be correct or otherwise.

First, with regard to that much discussed luminary—our moon. By some all weather changes are referred to that source. Others limit its influence by looking thither for prognostications of bad weather only. For ages the connections of the moon's position relative to the earth, and its appearance as seen through our atmosphere, have swayed the minds of men always; by instinct, peering into the veiled future. When we consider the undoubted relationship of the moon to the ocean tides, we cannot deny it an influence over our own planet as yet uncomprehended. On the other hand, knowing that temperature is the base of all meteorological conditions, and that the effect of the direct moonlight upon a thermometer fully exposed to it, and free from terrestrial radiation, is scarcely appreciable, I cannot adhere to the popular theories concerning dispersion and accumulation of cloud being largely attributable to the moon's apparent size. Upon the first thought, one considering that where there is light there ought to be sensible heat—an erroneous supposition—would infer that the cloud vapours should be rolled away by the moonlight; and in some places it is a common saying at or near the time of full moon that it will not rain, or snow much, as "the moon is too big." This is a complete fallacy;

and I will show from these Nova Scotian records, that both the frequency and quantity of precipitated moisture are entirely independent of the moon's size. I take first a month from the past winter—March—which, with its snow storms, will not soon be forgotten in this Province. In the first 24 days of March we had six separate heavy snow storms, besides two quiet falls, and several light flurries; also one rain storm. They are here in order, with the moon's condition at the time noted:—

A snow storm beginning at midnight of 2nd, and ending afternoon of 3rd. Moon 24 days old, and above the horizon during storm in early morning. On 5th, a snow storm from 6 a. m. to 1½ p. m.; moon 26 days old. Whole storm during daylight. On 7th, snow storm for short time in forenoon; and moon 28 days old. After a little snow, a rain storm during afternoon and evening of tenth, with a moon 1 day past new. During afternoon and night of 12th a bitter snow storm, extending into 13th with heavy squalls. Moon between 3 and 4 days old. 15th—the most violent snow storm of this stormy month, from 9 a. m. to 5–40 p. m. Moon 6 days old, and within one of first quarter. A fall of nearly two inches began before midnight of 17th and lasted till 10 a. m. 18th with the moon in its ninth day. In afternoon of 19th, with a 10 days moon, another quiet fall of nearly 3 inches of snow occurred. Lastly, in this series, before 1 o'clock of the morning of 24th a violent snow storm set in, lasting, with little intermission, till late that afternoon. This was on the moon's 15th day, and shortly before it was actually full.

Examination of other months taken at hazard, shows like results. August, 1871, will suit our purpose as well as any month. Then we had rain, generally heavy, during 1st afternoon and following night. Showery on the 3rd, and a storm on the 5th. Violent rain on the 9th morning, and showers during 10th and 11th. Not so much wet weather in middle of month, but on 17th there fell a fine misty rain all day. A rainy evening on the 24th; rain almost constant from morning of 27th to that of 28th, succeeded by intermittent falls on 30th and 31st, closed last August.

So that, reviewing these memoranda, rain, clouds, and clear sky are noticed entirely independent of the moon's age. For instance, taking up weeks, we had much rain, and the sky was invisible on the 1st; thorough cloud and heavy rain on the 9th, with no clearing till near midnight. The 17th a rainy clouded day. Very little break in the clouds on the 24th, and rain in the evening. Again on the 7th, 15th, 22nd, and 29th, the sky was either quite or mostly clear. Proving that at any stage of the moon's circuit, storms may occur, or fine weather be enjoyed.

There are some theories regarding lunar halos, and coronæ—commonly called indiscriminately, "Circles round the moon"—which are interesting to examine, as these popular ideas are not completely false, being based upon truth. These circles are generally believed to herald rain or snow; and in so far as they betoken a moist atmosphere these signs are correct. But moisture need not be precipitated upon the spot where it is formed. First, let us distinguish between the larger and smaller lunar circles—between halos and coronæ. Halos themselves are of two sizes; always either of 90 or 45 degrees, according to the younger Herschel. The two sizes are generally seen separately, but may appear at once. They are more common in winter than in summer, and sometimes a month passes without one being seen. The prismatic colours are more or less distinct; here generally pale and undefined at their edges, but the red always inside. Halos are formed by the rays reflected and refracted by the icy crystals which make up the high and feathery clouds known to meteorologists as cirri.

Coronæ are in fact interference colours arranged in this shape by the moon's light, with the blue nearest the centre; at times but one, at times several of these circles are observed; but always concentric and larger or smaller according to the size of the watery globules in the atmosphere. As has been said the light thrown from the moon and broken upon clouds passing causes this phenomenon, which seems to be a more sure forerunner of rain or snow than the halo, as it indicates an atmosphere nearly saturated far from Earth. Still even in this case precipitation need not immediately follow. I proceed to the proof.

In 1869, 12 lunar halos were here observed. In four cases we had decided rain or snow; in four cases cloudy weather with some slight precipitation; and on the remaining four following days clear weather. Observations of coronæ for that same year give a large proportion of succeeding wet days, but not as a necessary sequence.

In 1871—and I take years not immediately following, that the series may be less partial, though necessarily brief—I counted 6 lular halos and 17 coronæ. The former were exactly divided as to their successors: three wet and three fine days. The latter were also very nearly so, being followed by 9 wet days, and 8 dry. Summing up these 35 observations, we find the halos preceding wet and dry days, in the proportion of 5 to 4, and the coronæ giving a percentage of result closely similar. By a wet day I mean a day on which precipitation is appreciable—or in other words measures .01 inch in the guage. If we include fog and mist, and all kinds of inappreciable precipitation in our calculation, the resulting dry days will dwindle to one third of the whole, after the two species of moon rings.

To separate truth from error, then, both halos and coronæ indicate moisture, and are therefore frequently followed by rain or snow; but not necessarily so, as the condition of the earth and the different strata of atmosphere must be carefully considered, especially in connection with their capacity to hold moisture.

The phenomenon variously known as hoar frost, white frost, and rimy frost, is very widely considered to be a sure forerunner of a change from fair weather to foul. There is an atom of truth to induce this belief, but I think that it can be shown that the general deduction from this small source is erroneous. Indeed this belief is directly contradicted by another, viz., that a dew at night is followed always by a dry day. Both of these suppositions cannot be correct, for the difference between hoar frost and dew is merely one of season. Dew may be called the summer hoar frost, and this the winter dew. I need scarcely say here that terrestrial radiation is the cause of these deposits. By the casting off of heat, the earth's surface, as the sun's rays fall more and more obliquely, becomes cooler, till the dew point is reached, and the moisture of the warmer air becomes visible. Naturally, then, we should expect this phenomenon to occur every night; and it would do so were all conditions always fulfilled; but a clouded sky is a blanket to the earth, and confines and throws back again its lost temperature. Brechan tells us that Glaisher has observed passing clouds to raise the temperature of raw wool, much cooled by radiation, 15° in 15 minutes. Wind also, by transferring and mixing strata, obstructs terrestrial radiation, and dew or hoar frost deposits. We see now why a clear calm night is most favorable to these occurrences. Considering the above causes, it needs little reflection to see that neither dew nor hoar frost is a sign of either fair or foul weather to come.

Let us take last year—1871—and observe what did actually succeed these phenomena in the 131 instances recorded. I saw hoar frost 43 times, and dew on 88 nights, with these results:—On 19 occasions the days following deposits of hoar frost on the previous evenings were without precipitation, giving 44 per cent. against the prediction, and 56 in its favour,—while after 36 observations of dew appreciable rain fell, giving 41 per cent. adverse to the popular creed, and 59 per cent in its favour. So that regarding both forms of this phenomenon no certain conclusion, as to their effect, can be arrived at, beyond the established fact that their influence, if any, is not perceptible in the precipitation of the 24 hours immediately succeeding. In former papers—to be found in the Transactions of this Institute for 1870 and '71—I have endeavoured to dispel the notorious idea that displays of aurora are always followed by gales and foul weather; and that a high barometer must mean fine weather, and a low standing column the opposite. These conclusions have been hastily formed in the public mind from insufficient data; and the instances when the opinion has proved correct have left indelible marks upon the judgements of superficial observers, while the contrary results have readily faded from the willing memories.

The truth is that the branch of the science including prediction, is as yet scarcely shooting forth. No man, unaided by telegraphic reports, can from his own observations at a single station, at present prophecy the coming weather, beyond 24 or 36 hours, with any approach to certainty. For this purpose, we now need—and probably always shall need—reports at least twice a day from connected stations. Having these, and the climatic peculiarities of our own neighbourhood being fairly known, tolerable accuracy will already attend the constant and careful consideration of a pains-taking observer. Through the public press, and private ears, I have lately urged the beginning of a weather signal system for which this country is now ripe. If on a future evening I can report to this Institute—from which I have received so much encouragement for several years—the beneficial working of such a system, I shall be satisfied.

While for centuries false ideas, mingled with tiny truths, have gained general credence, let us now pursue an opposite course, and place faith only in substantiated doctrines.

I conclude this somewhat rambling paper with extracts from correspondence passing during last winter, illustrative of some of the details of weather telegraphy. These first remarks came to my hands from Mr. Kingston, chief meteorological superintendent at the central station for Canada—Toronto :—

"The present form of weather telegraphy is to record at numerous points the readings of the instruments, and certain facts descriptive of the weather, three times in the 24 hours; the observations being made simultaneously at all the stations, and *regularly*, in fine as well as in bad or threatening weather. According to the new Washington code the message from each station consists of ten words, and, subject as they are in the States, to numerous and varied combinations, the message there could hardly allow of compression ; but I have little doubt that, with our far more simple mode of operation the ten words could be reduced to six. Hence, if you were to have reports from ten stations combined, you would have, for each observation, one message of 60 words."

"It will be the duty of the agent" (*i. e.* the chief meteorological agent in each District, or Province ; which post in Nova Scotia I have the honour to hold) "to superintend the translation of the telegrams, and arrange the figures in the form of a weather bulletin, which exhibits the present atmospheric conditions, and the changes since the previous report. Two or three copies of the bulletin should be posted in conspicuous places ; and it should also be printed in the daily papers. It will be desirable hereafter to put up large maps, with variable symbols, which may indicate in a visible manner the progressive changes. In addition to receiving telegraphic intelligence from the continent at large, it would be desirable for each large centre of commerce, such as Halifax, St. John, &c., to be surrounded, as it were, by a cordon of ports at a moderate distance, from which telegrams need not be sent regularly, but only when they are asked for. This supplementary arrangement had better be postponed till the larger system is in operation; but its establishment should be kept in view as an important adjunct."

Mr. Kingston gives further valuable information regarding expense; but as that is, and will be, subject to modifications of different kinds, I add nothing on that head just now.

From the Meteorological office at London, G. B., I have lately received the following useful suggestions. Mr. Robert H. Scott the Director there, writes to me:—

"I should say that it would be best to place all the stations in connection with the Central office."

"The various nations here are establishing centres of their own. These exchange reports daily, and send extra telegrams to each other whenever a storm is reported. Each office then decides for itself whether or not it will warn its own coast. This is the plan we have introduced, and it is adopted by Holland and Norway; Sweden and Denmark are also about to take it up, and Russia will probably follow suit. The French system of extensive generalization gives a magnificent view of the general conditions, but does not enable you to draw conclusions for local storms and weather. It is also perfectly impossible for a distant central station to keep its observers in check. Telegraphic errors are our bête noir, and it is expensive work asking for repetitions over long lines; consequently the French reports are seldom if ever corrected before publication, and errors of an inch sometimes appear in their charts, and are never subsequently corrected. I should, therefore, say that Halifax ought to warn its own coast; speaking purely from a geographical point of view. A central station in Canada cannot get news of sudden changes in time. We send by post lithographed copies of our daily weather reports, for exhibition at seaports; but in our warning messages we hardly ever send any actual readings at all. The storm signal we use is the drum, and we hang up under it in a frame the order to hoist it."

I hope next year to speak of the weather signal system of the Dominion, in a more advanced stage.

Latitude 44° 39′ 20″ North. 2 feet.

1871.	Jan'y.	Feb'	Nov.	Dec.	Year 1871.
Mean Temperature	22°.60	22°.	2°.74	24°.63	41°.94
Difference from Normal (nine years)	-.24	-1°.	5°.09	-1°.56	-1°.24
Maximum Temperature	49°.4	47°	54°.3	48°.8	87°.2
Minimum Temperature	-13°.7	-7°	8°.2	-3°.7	+13°.7
Monthly and Annual Ranges	63°.1	55°	46°.1	52°.5	100°.9
Mean Maximum Temperature	30°.62	30°.	8°.91	32°.61	51°.30
Mean Minimum Temperature	13°.72	13°.	7°.18	15°.52	33°.93
Highest Daily Mean Temperature	45°.37	40°.	5°.47	43°.31	68°.85
Lowest Daily Mean Temperature	-6°.50	-0°.	0°.45	4° 41	-6°.50
Mean Daily Range of Temperature	16°.90	17°.	1°.73	17°.09	17°.41
Greatest Daily Range of Temperature	38°. 0	32°	23°.5	28.°6	38°.0
Mean Terrestrial Radiation	....	.....	9°.94	....	....
Mean Pressure, corrected	29.965	29.7	9.626	29.773	29.787
Difference from Normal (nine years)	+.223	-.0	-.096	+.044	+.026
Maximum Pressure	30.643	30.3	0.397	30.596	30.643
Minimum Pressure	29.065	28.9	8.905	29.018	28.905
Monthly and Annual Ranges	1.578	1.4	1.492	1.578	1.738
Highest Daily Mean Pressure	30.613	30.3	0.263	30.395	30.613
Lowest Daily Mean Pressure	29.143	29.0	29.095	29.145	29.008
Mean Pressure of Vapour	.118	.0	159	.118	.248
Mean Relative Humidity	81.7	72	81.0	79.7	79.1
Mean Amount of Cloud	7.21	5.	5.60	6.65	6.0
Difference from Normal (five years)	+.73	-.	-1.20	-.04	0
Prevalent Direction of Wind	W.N.W.	W.N.	N.W	W.N.W.	W.N.W.
Mean Velocity of Wind	11.95	11.	15.39	9.69	10.10
Amount of Rain	2.38	4.	3.21	1.88	41.31
Difference from Normal (nine years)	-1.40	+	-1.30	-1.63	-1.91
Number of days Rain	8		7	8	112
Difference from Normal (nine years)	+ 2		-5	-1	-10
Amount of Snow	14.7	19.	10 0	24.8	97.3
Difference from Normal (nine years)	-1.25	+5.	+5.7	+9.5	+22 1
Number of days Snow	10		6	13	46
Difference from Normal (nine years)	0	-	+2	+3	-1
Total Precipitation	3.73	5.	4.18	4.39	51.14
Difference from Normal (nine years)	-1.92	+.	-.82	-.39	-.35
Number of Dry Days	16	[illegible]	20	14	220
Difference from Normal (nine days)	-1		+5	0	+14
Number of Auroras	0	[illegible]	6	2	54
" Gales	2	[illegible]	5	4	26
" Fogs	6	[illegible]	2	3	57
" Dews	0	[illegible]	0	0	88
" Hoar Frosts	3	11	5	4	43
" Thunders	0	[illegible]	0	0	6
" Lightnings	0	[illegible]	0	0	7
" Hails	0	[illegible]	0	0	3
" Rainbows	0	[illegible]	0	0	7
" Lunar Halos	2	1	0	1	10
" Lunar Coronæ	0	[illegible]	0	3	15
" Solar Halos	0	[illegible]	0	0	1
" Days Sleighing	14	17	0	14	48

General Meteorological Register for 1871.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea, 132 feet.

OBSERVED BY F. ALLISON.

1871.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year 1871.
Mean Temperature	22°.60	22°.06	32°.99	36°.90	46° 68	56°.13	62°.76	62°.58	54°.72	48°.44	32°.74	24°.63	41°.94
Difference from Normal (nine years)	–.24	–1°.57	+4°.28	–1°.26	–.83	–3°.52	–.58	– 58	–2°.60	+.26	–5°.09	–1°.56	–1°.24
Maximum Temperature	49°.4	47°.3	52°.8	62° 8	87°.2	77°.9	82°.1	83°.0	80°.9	71°.8	54°.3	48°.8	87°.2
Minimum Temperature	–13°.7	–7°.7	16°.2	23°.6	28°.3	37°.3	45°.0	44°.3	35°.1	28°.3	8°.2	–3°.7	+13°.7
Monthly and Annual Ranges	63°.1	55°.0	36° 6	39°.2	58°.9	40°.6	37°.1	38°.7	45°.8	43°.5	46°.1	52°.5	100°.9
Mean Maximum Temperature	30°.62	30°.81	41°.56	44°.55	58°.82	68°.48	73°.79	73°.85	64°.98	56°.64	38°.91	32°.61	51°.30
Mean Minimum Temperature	13°.72	13°.26	25°.90	31°.13	37°.05	47°.19	54°.99	54°.80	46°.31	40° 16	27°.18	15°.52	33°.93
Highest Daily Mean Temperature	45°.37	40°.04	43°.16	48°.52	64°.23	63°.26	67°.54	68°.85	66°.32	60°.51	45°.47	43°.31	68°.85
Lowest Daily Mean Temperature	–6°.50	–0°.72	25°.71	28°.95	33°.93	51°.51	54°.29	57°.32	44°.85	35°.85	10°.45	4° 41	–6°.50
Mean Daily Range of Temperature	16°.90	17°.84	15°.67	13°.42	21°.77	21°.72	18°.79	19°.04	18°.66	16°.35	11°.73	17°.09	17°.41
Greatest Daily Range of Temperature	38°. 0	32°.1	24°.4	27°.6	32°.0	32° 8	27°.2	29°.9	27°.6	26°.2	23°.5	28.°6	38°.0
Mean Terrestrial Radiation	....	....	....	....	34°.77	46°.03	53°.50	53°.10	43°.31	37°.50	29°.94	....	....
Mean Pressure, corrected	29.965	29.749	29.784	29.694	29.723	29.748	29.814	29.815	29.885	29.874	29.626	29.773	29.787
Difference from Normal (nine years)	+.223	–.024	+.053	–.034	+.030	–.003	+.058	+.060	+.047	+.079	–.096	+.044	+.026
Maximum Pressure	30.643	30.370	30.345	30.218	30.286	29.984	30.212	30.369	30.347	30.464	30.397	30.596	30.643
Minimum Pressure	29.065	28.911	29.094	29.002	29.031	29.272	29.368	29.311	29.451	29.036	28.905	29.018	28.905
Monthly and Annual Ranges	1.578	1.459	1.251	1.216	1.255	0.712	0.844	1.058	0.896	1.428	1.492	1.578	1.738
Highest Daily Mean Pressure	30.613	30.303	30.278	30.120	30.209	29.941	30.133	30.300	30.266	30.411	30.263	30.395	30.613
Lowest Daily Mean Pressure	29.143	29.008	29.165	29.181	29.154	29.475	29.454	28.480	29.537	29.484	29.095	29.145	29.008
Mean Pressure of Vapour	.118	.099	.152	.179	.232	.345	.462	.465	.359	.288	159	.118	.248
Mean Relative Humidity	81.7	72.5	76.4	80.7	72.3	77 1	81.5	82.9	81.9	81.3	81.0	79.7	79.1
Mean Amount of Cloud	7.21	5.40	6.49	7.43	5.38	5.65	6.19	5.88	4.79	5.18	5.60	6.65	6.0
Difference from Normal (five years)	+.73	–.80	+.63	+1.06	–1.35	–.04	+.52	+.69	–.99	–.42	–1.20	–.04	0
Prevalent Direction of Wind	W.N.W.	W.N.W.	N.W.	N.	N.W.	S. E.	S.W	N.W.	W.N.W.	S W.	N.W	W.N.W.	W.N.W.
Mean Velocity of Wind	11.95	11.36	12.29	13.23	10.94	7.30	4.87	5.72	8.46	9.99	15.39	9.69	10.10
Amount of Rain	2.38	4.11	4.39	3.42	2.59	2 96	3.38	3.69	4.81	4.49	3.21	1.88	41.31
Difference from Normal (nine years)	–1.40	+ 61	+1.24	+.28	–1 55	+.05	+1.06	+.48	+.87	–.55	–1.30	–1.63	–1.91
Number of days Rain	8	6	8	11	10	12	12	14	8	8	7	8	112
Difference from Normal (nine years)	+ 2	0	+2	0	–5	0	+2	+3	–2	–4	–5	–1	–10
Amount of Snow	14.7	19.3	15.1	13.4	Inap.	0	0	0	0	0	10 0	24.8	97.3
Difference from Normal (nine years)	–1.25	+5.79	–1.5	+4.9	–.1	0	0	0	0	–.6	+5.7	+9.5	+22 1
Number of days Snow	10	7	7	3	0	0	0	0	0	0	6	13	46
Difference from Normal (nine years)	0	–1	–1	–2	–1	0	0	0	0	–2	+2	+3	–1
Total Precipitation	3.73	5.88	6.16	4.88	2.59	2.96	3.38	3.69	4.81	4.49	4.18	4.39	51.14
Difference from Normal (nine years)	–1.92	+.08	+1.73	+.77	–1.56	+.05	+1.06	+.48	+.87	–.65	–.82	–.39	–.35
Number of Dry Days	16	16	18	16	21	18	19	17	22	23	20	14	220
Difference from Normal (nine days)	–1	0	0	–1	+5	0	–2	–3	+2	+9	+5	0	+14
Number of Auroras	0	4	3	7	8	3	3	7	6	5	6	2	54
" Gales	2	3	3	5	1	0	0	0	0	3	5	4	26
" Fogs	6	3	4	2	3	7	15	9	2	1	2	3	57
" Dews	0	0	2	1	6	13	14	18	21	13	0	0	88
" Hoar Frosts	3	11	8	5	2	0	0	0	2	3	5	4	43
" Thunders	0	0	0	1	1	3	1	0	0	0	0	0	6
" Lightnings	0	0	0	1	1	2	1	2	0	0	0	0	7
" Hails	0	0	0	1	1	1	0	0	0	0	0	0	3
" Rainbows	0	0	1	0	2	2	0	2	0	0	0	0	7
" Lunar Halos	2	1	2	1	1	1	0	0	0	1	0	1	10
" Lunar Coronæ	0	0	0	0	2	2	3	3	1	1	0	3	15
" Solar Halos	0	0	0	0	0	0	1	0	0	0	0	0	1
" Days Sleighing	14	17	2	1	0	0	0	0	0	0	0	14	48

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE, HALIFAX, NOVA SCOTIA.

PATRON—His Honor the LIEUTENANT-GOVERNOR.

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J. R. DEWOLF, ESQ., M. D.,
J. RUTHERFORD, ESQ., M. E.,
H. MOODY, ESQ.,
W. GOSSIP, ESQ.,
J. BELL, ESQ.,
ANGUS ROSS, ESQ.

The Anniversary Meeting of the Institute is held on the *Second Wednesday* in October, of every year.

The Monthly Ordinary Meetings of the Institute, when Papers are read, are held on the second Monday evening in every month, commencing in November and ending in May.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. III. 1872-73. PART III.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 103 GRANVILLE ST.

ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.

UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.

1873.

Price Five Shillings

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. III. PART III.

Provincial Museum, Oct. 9th, 1872.

ANNIVERSARY MEETING.

J. M. JONES, ESQ., *President, in the Chair.*
Inter Alia.

A VOTE of thanks to the President for his very valuable services was proposed and carried by acclamation.

The following office-bearers for the next year were then elected.

President—J. M. JONES, Esq.

Vice Presidents—Dr. GILPIN, and Dr. LAWSON.

Treasurer—W. C. SILVER, Esq.

Secretaries—Rev. Dr. HONEYMAN, and ANGUS ROSS, Esq.

Council—Dr. DEWOLFE, Rev. Dr. WARREN, FRED. ALLISON, Esq., A. RUTHERFORD, Esq., WM. GOSSIP, Esq., Dr. REID, ADAM MCKAY, Esq., W. C. SILVER, Esq., Sheriff BELL, Dr. LAWSON, Rev. Dr. HONEYMAN, Dr. GILPIN, ANGUS ROSS, Esq.

A vote of thanks to the Halifax Press, for insertion of notices of meeting, gratuitously, and for readiness shown in the insertion of communications relating to the work of the Institute, was proposed and carried unanimously.

B. Cochran, Esq., Postmaster, Halifax, Henry Poole, Esq., Inspector of Mines, Henry Y. Clarke, Esq., were proposed as members,—Jabez Turner, Esq., of Madden Grange, Peterboro, England, a Corresponding Member.

Dr. REID then made a few observations on the establishment of Salt and Fresh water Aquaria. He showed the desirableness of having these valuable auxiliaries to Public Instruction.

Members were agreed in considering Aquaria desirable, but were not prepared to recommend their establishment by the Institute.

ORDINARY MEETING, NOVEMBER 11, 1872.

DR. GILPIN, *V. P., in the Chair.*

IT was announced that Messrs. B. COCHRAN, HENRY S. POOLE, and HENRY Y. CLARKE, proposed as members at last meetiug, and Mr. JABEZ TURNER, proposed as Corresponding Member, had been duly elected by the Council.

Dr. HONEYMAN then read a paper "*On Crystalline Rocks of Nova Scotia and Cape Breton.*"

Dr. GILPIN read a paper "*On the Eagles of Nova Scotia.*"

ROBT. MORROW, Esq., made a few observations on the anatomy of the "Moose." He stated that he had examined the Moose very particularly during the past hunting season, and had ascertained beyond doubt that the Moose had no gall bladder. This was in answer to a question that had been asked at a meeting last Session, when Dr. Gilpin read his paper on the Moose.

Mr. MORROW also showed an illustration of the malformation of a kidney of a Moose, while the other kidney was properly formed.

ORDINARY MEETING, DEC. 9, 1872.

Inter alia.

THE following gentlemen were proposed as members: the Hon. Wm. B. Vail, *Provincial Secretary;* Mr. Edward Binney; Mr. G. A. Sandford; T. B. Akins, D. C. L.; Mr. Alexander James.

The CHAIRMAN then made some observations on a specimen of *Corregonus albus* from Labrador, directing attention to its structural peculiarities.

Dr. REID read an elaborate paper "*On the Economy of Timber and the preservation of Structures from fire and decay.*"

The paper was illustrated by interesting experiments showing principally the manner in which wood, prepared by a solution of silica or otherwise, resisted combustion. The reading of the paper was followed by a lengthy discussion in which difficulties were suggested, and other processes for preserving timber for special purposes described.

ORDINARY MEETING, JAN. 13, 1873.

SHERIFF BELL *in the Chair.*

Inter alia

IT was announced that the Council had duly elected as members the Hon. W. B. VAIL, T. B. AKINS, D. C. L., Messrs. EDWARD BINNEY, ALEX. JAMES, G. SANDFORD.

Mr. H. S. POOLE read a paper "*On the Great American Desert, and the effects of Subaerial action on the constituents of mineral veins in that region.*"

ORDINARY MEETING, FEBRUARY 10, 1873.

DR. GILPIN, V. P., *in the Chair.*

Inter alia.

THE following gentlemen were proposed as members: the Hon. James McDonald, M. P., Mr. E. Mosley, Mr. G. P. McNab, Mr. F. H. Baker.

Dr. GILPIN read an elaborate and interesting paper, "*On the Stone Age in Nova Scotia.*"

Rev. Dr. Honeyman read a paper "*On the Metamorphism of Rocks in Nova Scotia and Cape Breton.*"

Mr. H. Poole from Cape Breton being present, as about to take farewell of the Institute, it was proposed, seconded, and carried by acclamation, "That the Institute express a sense of obligation to Mr. Poole for the interest he had taken in its Transactions since its establishment, and of the regret at the prospect of his leaving the Province, and consequently of his ceasing to be an actual member." A hope was at the same time expressed that Mr. Poole would still continue to take an interest in the prosperity of the Institute, and favor it with occasional correspondence. Mr. Poole gave some account of his connection with the Institute. He was one of the few surviving members who first met to organize this Institute, and he contrasted the circumstances under which they then met, with the elegant place and surroundings of their present meeting. He also intimated that he had presented his valuable Geological Collection to the Provincial Museum, where it would be available for the use of the Institute, and gave assurance that he would still continue to take an interest in its Proceedings.

Ordinary Meeting, March 10, 1873.

Dr. Gilpin, *V. P., in the Chair.*

Inter alia.

It was announced that the Hon. J. McDonald, M. P., Mr. E. Moseley, Mr. G. P. McNab, and Mr. F. H. Baker, had been duly elected by the Council as members of the Institute.

It was proposed and seconded, that Mr. H. Poole be elected Corresponding Member, and Mr. Edwin Gilpin an Associate Member.

Mr. Edwin Gilpin having been called upon by the Chairman, read an excellent paper "*On the grouping of the Pictou Coal Seams.*"

Mr. Fred. Allison then read a paper by Mr. H. Poole, "*On the Meteorology of Glace Bay, Cape Breton.*"

Ordinary Meeting, April 14, 1873.

Dr. Gilpin, *V. P., in the Chair.*

Inter alia.

It was announced that Mr. H. Poole had been duly elected by the Council as a Corresponding Member, and Mr. Edwin Gilpin an Associate Member.

Mr. A. Ross, Secretary, read a letter from the President, J. M. Jones, Esq., containing notes "*On the Historical Features of the Bermudas.*"

Mr. Gossip then read a paper "*On the Affinity of Races.*" This paper which was lengthy and elaborate advanced many interesting and curious views, somewhat different from those generally received.

Ordinary Meeting, May 12, 1873.

Dr. Gilpin, *V. P. in the Chair.*

Inter alia.

Mr. Peter Jack was proposed and seconded as a member.

Mr. Forshaw Day, Artist, read a very interesting paper "*On the Specific characters of English and American Skies and Clouds.*"

Mr. Allison read an excellent paper "*On Progress in Weather Knowledge.*"

The Rev. Dr. Honeyman read "*The Story of a Nova Scotian Boulder.*"

D. Honeyman,
Secretary

LIST OF MEMBERS.

Date f Admission.			
1873.	Jan.	11.	Akins, T. B., D. C. L , Halifax.
1869.	Feb.	15.	Allison, Augustus, Halifax.
1869.	Feb.	15.	Allison, Frederick, Halifax.
1873.	Mar.	10.	Baker, F. H., 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.
1864.	Nov.	7.	Brown, C. E., Halifax.
1872.	Nov.	11.	Clarke, H. Y., Halifax.
1872.	Nov.	11.	Cochran, B., Post Master, Halifax.
1867.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
1868.	Sep.	28.	Collins, Brenton, Halifax.
1871.	April	4.	Compton, William, Halifax.
1872.	April	12.	Costley, John, Halifax.
1863.	May	13.	Cramp, Rev. Dr., Wolfville.
1870.	Mar.	30.	Day, Forshaw, Artist, Halifax.
1863.	Oct.	26.	DeWolf, James R., M. D., Edin., L. R. C. S. E., Dartmouth.
1863.	Dec.	7.	Downs, Andrew, *Cor. Memb. Z. S.*, Halifax.
1871.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
1865.	Oct.	4.	Fleming, Sandford, C. E., *Chief Engineer Dom. Railways*, Halifax.
1872.	Feb.	12.	Foster, James, Barrister-at-Law, Halifax.
1863.	Jan.	5.	Fraser, R. G., Mineralogist, Halifax.
1863.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., VICE PRESIDENT, Halifax.
1863.	Feb.	2.	Gossip, William, Granville St., Halifax.
1863.	Jan.	26.	Haliburton, R. G., F. S. A., Halifax.
1863.	June	27.	Hill, P. C., D. C. L., Halifax.
1866.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., &c., SECRETARY, Halifax.
1868.	Nov.	2.	Hudson, James, M. E., *Superintendent Albion Mines*, Pictou.
1872.	Feb.	5.	Hunt, Rev. A. S., *Superintendent of Education*, Halifax.
1873.	Jan.	11.	James, Alex., Barrister-at-Law, Halifax.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., PRESIDENT, Halifax.
1866.	Feb.	1.	Kelly, John, *Deputy Chief Commissioner of Mines*, Halifax.
1864.	Mar.	7.	Lawson, Geo., Ph. D., L. L. D., VICE PRESIDENT, *Prof. of Chem. and Natural History*, Dalhousie College.
1872.	July	5.	Lawson, Walter, C. E., Montagu Coal Mines.
1871.	April	4.	Leitch, A., H. M. Dockyard.
1872.	May	1.	Longley, J. W., Halifax.
1873.	Mar.	10.	McDonald, Hon. James, M. P., Halifax.
1869.	Dec.	3.	Moody, Harry, *Pri. Sec'y of His Honor the Lieut. Governor* Sir Hastings Doyle.
1872.	Feb.	12.	McKay, Adam, *Engineer*, Dartmouth.
1872.	Mar.	2.	Mooney, Andrew, Halifax.
1873.	Mar.	10.	McNab, G. P.

1866.	Feb.	3.	Morrow, James B., Halifax.
1872.	Feb.	13.	Morrow, Robert, Halifax.
1868.	Nov.	25.	Morley, Lieut. R. A.
1873.	Mar.	10.	Moseley, E., Dartmouth.
1870.	Jan.	10.	Murphy, C. E., Halifax.
1865.	Aug.	29.	Nova Scotia, the Rt Rev. Hibbert Binney, D. D., Lord Bishop of
1872.	Nov.	11.	Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.
1870.	Jan.	20.	Power, L. G., *Barrisler-at-Law*, Halifax.
1866.	July	28.	Reeks, Henry, Manor Hall, Truxton, Hamp. England.
1871.	Nov.	29	Reid, A. P., M. D., Halifax.
1868.	Dec.	29.	Roue, John, Halifax.
1869.	June	27.	Ross, Angus, SECRETARY, Halifax.
1866.	Jan.	8.	Rutherford, John, M. E., Halifax.
1872.	Jan.	13.	Sandford, G. A., Halifax.
1864.	Mar.	7.	Silver, W. C., TREASURER, Halifax.
1868.	Nov.	25.	Sinclair, John A., Halifax.
1872.	May	1.	Stewart, J. J., Halifax.
1865.	April	20.	Smithers, George, Halifax.
1867.	Aug.	16.	Tobin, Stephen, M. P., Halifax.
1873.	Jan.	13.	Vail, Hon. W. B., *Provincial Secretary*, Halifax.
1871.	Nov.	29.	Warren, Rev. Dr., Halifax.
1864.	May	16.	Whytal, John, Halifax.
1866.	Mar.	18.	Young, *Sir* William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
1870.	Oct.	27.	Elder, Rev. Prof., Acadia College, Wolfville.
1868.	June	13.	Ford, Alfred S., London, England.
1873.	April	11.	Gilpin, Edwin, Halifax.
1864.	July.	1.	Marett, Elias, St. John's, Newfoundland.
1872.	Feb.	5.	McKay, Alexander, *Principal of Schools*, Dartmouth.
1865.	Dec.	28.	Morton, Rev. John, Trinidad.
1872.	Mar.	27.	Moseley, E. T., *Barrister-at-Law*, Cape Breton.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. T., Charlottetown, Prince Edward Island.
1868.	Nov.	25.	Bethune, Rev. J. S., Ontario.
1866.	Sept.	29.	Chevalier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1871.	Nov.	1.	Cope, Rev. J.C., PRESIDENT of the 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, John, Madden Grange, Peterboro, England.

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. 1. Notes on the Geology of Nova Scotia and Cape Breton. By Rev. D. Honeyman, D. C. L., F. G. S. &c., *Director of the Provincial Museum.*

(*Read Nov.* 11, 1872)

I purpose to direct attention to the results of a detailed examination of the metamorphic rocks of the interesting localities to which my attention was directed last summer. The first in order was in Cape Breton at George's River, in the vicinity of the Sydney portion of the great Cape Breton Coal Field. George's River is a small inlet of the Bras d'Or near the Little Passage, having a brook flowing into it. When I arrived at the head of the inlet, I observed an outcrop of red syenite at the bottom of the mountain, and near it the remains of an old excavation. The latter consisted chiefly of weathered serpentine. I then examined more particularly the heap of material taken from a shaft recently sunk at a short distance west of the old excavation. Here the prevailing rocks were a beautiful white calcite and dark green serpentine. I was at once assured that I had before me a counterpart of the metamorphic, syenite, serpentine, and calcite, of Arisaig, Nova Scotia.

The other products of the shaft were small pieces of red jasper, parts of a vein of iron pyrites of three or four inches thickness, and a ponderous mineral of dark color chiefly, also iron pyrites. Of another excavation farther to the west the product was a white marble coarsely crystalline. Still farther on, for the distance of probably two miles the sides of the mountains showed extensive outcrops of marble. After this reconnaissance I commenced a regular examination with the assistance of Messrs. Bell and McQuarrie, starting about a mile to the east of the parts already mentioned. On the shore of the Bras d'Or we found the beginning of the red syenite of our former outcrop. Passing along westward we met a series of outcrops of red syenite, and at last reached the summit of a syenitic (George's) Mountain, having an elevation of 890 feet, according to the measurement of Capt. Bayfield. Descending the mountain we reached our first noticed outcrop of syenite. There we found the syenite and serpentine already referred to in all but immediate contact. Passing the excavations we mounted to the summit, and found blueish-colored marble, rising iu lofty and precipitous walls. Proceeding onward we found the marbles parted by bands of jaspideous rock; then followed beautiful serpentinous marbles and others. Our course was thus chiefly on the southern side of the mountain range. Wishing to ascertain whether the marbles and syenite were arranged as bands, we examined the opposite or northern side of the range, a distance of 6 miles, and observed continuous outcrops of red syenite, the limit of our examination being the second highest mountain of the range, having an elevation of 700 feet. (Bayfield.) Re-examining the mountain outcrops we found jutting out boldly between red syenite outcrops, diorite, similar to that at Arisaig. I had here another evidence of identity with the series of Arisaig. Subsequently we passed through the mountain range in rear of the marble, and after passing over outcrops of red syenite, probably a distance of a quarter of a mile, we reached the rear of the marble massive walls of beautiful ophiocalcite — serpentinous limestone. On the banks of George's River we find outcropping, thick beds of limestone having a lower carboniferous aspect.

In order to shew the relation of these to the metamorphic rocks already described, we have the aid of an excellent section of rocks on the shore of the Bras d'Or, having the syenite already noticed for its geological centre.

Beginning at the mouth of George's River, north side, we first exposed strata of limestone having a low dip. These are evidently lower carboniferous; they have abundance of small fossils chiefly *crinoidal* joints. These limestones when struck emit a strong odor of petroleum. To some distance the section is obscure, and then we find holes indicating the existence of underlying limestone. Then comes the syenite centre. Next to this, is a considerable thickness of greenstone; succeeding is a considerable thickness of lower carboniferous shales, much disturbed and contorted by the greenstone: in these are imbedded limestones. A projecting point shews limestone and shales, apparently forming the termination of a synclinal axis. There is also a thick bed of *brachiopodous* limestone, familiar in Nova Scotian and Cape Bretonian lower carboniferous Geology. They form a point on what we may call the mainland and the south end of Long Island. (See map of Nova Scotia.) These limestones are destitute of the petroleum odor.

Following the members of this section in their courses westward we have the crinoidal limestone evidently forming the substrata of the elevated bank on the north side of George's River. The limestones which I have already noticed as outcropping on the same bank are a continuation of that indicated by the holes of the section. This also has the strong petroleum odor. They directly overlie the syenites, serpentines, and marbles, the first of which are a continuation of the central syenite of the section. The greenstone extends westward for nearly a mile, forming with the carboniferous strata an elevation which partially obscures George's Mountain on the northern side. The carboniferous strata of Long Island are coextensive with the island, which is four miles in length. They dip into the channel at a very high angle, enabling the steamer to skirt the Island so as to make the minute details of structure in the strata distinctly visible to the passenger.

We have these lower carboniferous strata thus lying directly on the metamorphic rocks, but uncomformably. The carboniferous strata are a part of the Sydney carboniferous formation, consequently the metamorphic series which I have described are the pre-carboniferous rocks of this well known coal field.

Closely connected with the limestones of George's River are the limestones and gypsum that skirt the shores of Boulardarie Island, lying opposite. These limestones have also the petroleum odor.

I found in them abundance of the *Entomostraca*, *Leperditia*, and *Beyrichia*.

The examination of the metamorphic rocks of George's River, led to a re-examination of those related at Arisaig: of this I now give the results. This locality is unlike the other in this, that it is well known. It has been the subject of papers which are to be found in the Journal of the Geological Society and Silliman's Journal, and it has been referred to in one of my papers read before this Institute in 1870.

This publicity is to be regarded as premature, for although it is four years since I made the discovery of this series of rock, it was only last summer that I had the opportunity of making such an examination of them as I regarded necessary for arriving at satisfactory conclusions respecting their proper character, so that I am not astonished that the conclusions formerly deduced are not altogether so satisfactory as I could have wished.

I have already given general descriptions derived from a cursory examination made under very unfavourable circumstances. I now give a very minute description resulting from a thorough examination made with an intelligent assistant, and under the most favourable conditions. The whole series is here beautifully exposed in a fine shore section, so that on this consideration in addition to priority and completeness, it is to be regarded as typical. Like the George's River series, it has an easterly and westerly trend, so that it is in a manner parallel to it.

For the purpose of further comparison I shall commence at the north end of the Arisaig series, as I did with that of Cape Breton.

On the shore about miles from the north side of Cape George, we have first syenites of three distinct colors, white, cream colored, and red, with interbedded metamorphic quartzites of dark color. These syenites are fine grained and have very little hornblende, just enough to give them a syenitic character, and all contain crystals of green feldspar. This is the only place where I have seen these in the province. Its venation is also peculiar as far as my experience shows. Besides being of quartz they are pervaded by numerous veins of calcite; some of these are from four to six inches thick.

The metamorphic slates which intervene are also intersected by veins having a granitic composition, *i. e.* quartz with abundance of mica aggregations. These, in this character have some resemblance to the slates in the vicinity of Halifax, to which I have lately been directing attention. Proceeding with the section, we have diorites which project boldly into the sea; these pass into serpentine having considerable beds of serpentinous limestone, which extend into the diorite to the distance of about half a mile. This is the bed of the supposed *Eozoön*, and the supposed evidence of Laurentian age. Then we have diorite with quartz veins having abundance of talc foliated, and in prismatic crystals. Next comes diorite, perphyritic, with large crystals of amphibole. Then diorite with numerous veins of quartz and saccharine limestone. This is a character which it has in common with the syenite of the section. After this is diorite with blue crystalline limestone in lenticular beds and veins. Then hornblendic rock. Lastly, diorites with crystalline limestones, serpentine and serpentinous limestones.

This series is beautifully connected in its parts by blending, and by a sort of system of venation, the results of a common metamorphism, but still I regard it as composed of two divisions which probably belong to two different geological periods.

I regard the syenite, as belonging to the azoic period; and the diorites, argillites, ophites, and varieties of crystalline limestone, serpentinous and bluish as belonging to the Lower Silurian period.

I consider that there is here a sort of parallelism with rocks which I have lately examined in Halifax and environs. I shall have occasion to refer to this point in a future communication.

I would now show the relation which this Lower Arisaig series bears to the Upper Arisaig series, and to an associated formation. On the north-west side of the series there is necessarily obscurity, as the rocks pass into Northumberland Straits. On the south-east side the overlying rocks are lower carboniferous, consisting of conglomerate, grits, sandstones, and limestones. Toward Cape George they are succeeded by a considerable band of metamorphic argillites, which much resemble those of the Antigonish Sugar Loaf range. These as I have shown elsewhere, are in all probability Middle Silurian; they are well exposed along the shore, and in a fine cross section in a brook at a distance of about a mile from Cape George. There the band dips north. There are no fossils in these rocks, but there is a small bed of crystalline limestone (white marble,) which was doubtless a small fossiliferous bed, and was rendered crystalline by the same action which rendered the slates metamorphic. They are overlaid by a brecciated conglomerate hardened, and having quartz veins. The last is of lower carboniferous age. I was not aware of the existence of this band of argillites, until last season. This is bounded on the S. E. by a continuation of the lower carboniferous strata overlying the *lower series.* On the south-west there is trap and lower carboniferous conglomerate intersected and hardened by trap, with obscurity intervening between this and the upper Arisaig series (Middle and Upper Silurian.)

The lower member of the series in question is extensively distributed in Nova Scotia and Cape Breton. The syenites enter largely into the constitution of their mountain ranges, forming their highest elevations. They are overlaid either by middle silurian—fossiliferous or non-fossiliferous — or lower carboniferous. In several localities in Nova Scotia and Cape Breton, I have reason to believe that both members of the series exist, more or less complete. One of these is found in the Cobequids—the greater number exist in Cape Breton. *George's River* has been illustrated. I hope next season to be able to illustrate other localities equally satisfactory.

I would, however, in the meantime make a particular observation upon one of these localities. In the serpentinous strata of Whycocomagh, a vein of iron has been discovered, which is reported to be of economic importance. There can be no doubt that the containing rock belongs to the Lower Arisaig series. R. G. Fraser, Esq., has kindly furnished me with specimens of the rocks, which are unmistakably of the second number of the series. There are serpentinous schist and marble.

I would now direct your attention to the opinions of other geologists, on the subject before us, especially in reference to the rocks of George's River. Richard Brown, F. G. S., in his late admirable work, "On the Coal Fields and Coal Trade of the

Island of Cape Breton," London, 1871, thus writes page 4, "the limestones of this formation, (carboniferous) are well adapted for agricultural and building purposes, and in some places, in the vicinity of igneous rocks, furnish white, gray and variegated marble of good quality in great abundance." The "igneous rocks" are the syenites and diorites described; and the "white, gray and variegated marble," are our white, blue and serpentinous marbles.

In the geological map of Cape Breton, opposite the title page of Mr. Brown's work, and intended to illustrate it, I find the geology of George's River indicated by a broad band of carmine color, (igneous) and then a band of light purple metamorphic and Silurian, extending to George's River. This covers all the region of my survey from Long Island to George's River, and inserts a metamorphic and Silurian band between his igneous rocks and carboniferous, which would interfere with the conversion of any limestone of the latter by the igneous rocks into marble.

Dr. Dawson, in his Acadian Geology, specifies this district and its marble, under "Carboniferous System, Cape Breton County," page 419. He says, "An altered limestone which extends from the neighborhood of Long Island on the Little Bras d'Or, toward the East Arm, affords a gray and white marble."

This is substantially the same view in reference to the age and origin of the George's River marble, as given by Mr. Brown.

In answer to this view, I only adduce one incontrovertible fact, which proves that the contact of syenite with lower carboniferous limestone, does not produce marble. On the south side of Antigonish Harbor, there is a mountain consisting of syenite and lower carboniferous limestone, having syenite in direct contact with fossiliferous limestone throughout. On the summit the syenite and limestone form a breccia. The limestone and its fossils, which consist of connularia and entomastraca, are *entirely unaltered*. *Vide* specimens in the Provincial Museum and in the Museum of the Dominion Survey, Gabriel Street, Montreal.

In the Map of the Cape Breton Coal Field, Acadian Geology, page 413, I find that the geology of the whole George's River district under examination, is indicated by five parallel lines, and the capital letter F, which are explained as metamorphic Silurian. There is here also some discrepancy. I would observe that I have no objection to the indication as far as the serpentine and marble are concerned, provided it is explained metamorphic *Lower Silurian*

On comparing these rocks with the metamorphic rocks of the Paleological series of Eastern Canada, as described in the Geology of Canada, 1863, of the Canadian Survey, pages 597–618.

Canada.	*Nova Scotia.*	*Cape Breton.*
Beds of Jasper		George's River.
Argillites	Arisaig.	George's River.
Agalmatolite		George's River.
Diorite	Arisaig.	George's River.
Imbedded Hornblende Crystals, large	Arisaig.	
Talc	Arisaig.	George's River.
Serpentine	Arisaig.	George's River. Whycocomah.
Calcareous Ophedite	Arisaig.	George's River.
Limestone	Arisaig.	George's River.
Iron Ores		Whycocomah.

To the Eastward the rocks of upper Silurian and Devonian age, are found reposing on those of the Quebec Group.	At Arisaig, syenites and diorites are overlaid by middle and upper Silurian.

These coincidences are too numerous to be accidental, and when we consider that the rocks compared are at Gaspe and Arisaig on opposite shores of the Gulf of St. Lawrence, with Prince Edward Island only intervening, identity can scarcely be questionable.

The evidence of fossils is a desideratum for the complete solution of the problem of the age of these metamorphic rocks of Arisaig. At one time it was supposed by some that this evidence was also available. The discovery of the supposed Eozoon Canadense was considered as conclusive proof of the Laurentian age of the Arisaig serpentines. It was afterwards found that the tubulation of the Arisaig fossil was different from that of the Eozoon Canadense, and it was considered by Dr. Dawson that the rock in question might consequently be of later age. I must confess that I never attached much importance to the discovery of the supposed fossil, and consequently I always regarded its existence as proof of any age, rather questionable. Sir Wm. Logan at first entertained the opinion that the lower Arisaig Series, especially its serpentines, were probably of the age to which I now consider them to belong, but subsequently he changed his opinions.

There can be no question, however, that marine life was abundant at the period when the rocks of the lower Arisaig series were formed. The extent of the marbles, especially in Cape Breton, proves this. These marbles were doubtless originally fossiliferous limestones which were subsequently rendered crystalline by metamorphic action. I have already referred to a case of this kind in the metamorphic middle Silurian, near Cape George. The great development of these marbles shows that life then was at least equal in prevalence to that of the lower carboniferous period, and greater than that of the middle and upper Silurian. The latter under the most favorable circumstances, *e. g.* McAra's Brook, show limestones only in lenticular beds, a few inches in thickness, while the carboniferous has limestones of considerable extent and thickness.

I have shown that these marbles cannot be metamorphosed lower carboniferous limestones. It is, therefore, a just inference that they belong to another period which is known to have abounded in life, to the lower Silurian which includes the limestones of the Calciferous, Chazy and Trenton.

I consider that the syenites, diorites, porphyries and hornblende rock, are indigenous, *i. e.* resulting from the metamorphism of sedimentary rocks, belonging to an age preceding the Silurian—Azoic,—that they were subaërial during the Lower Silurian period,—that by the tear and wear of these, the argillites and quartzite were formed,—while at the same time the marine fauna of the period, were actively or passively forming limestone, that all were unitedly exposed to metamorphic or hydrothermal action, under pressure,—that the argillites were metamorphosed, the serpentines formed, and the limestones crystallized,—that the syenites and diorites were then fissured and pervaded with veins of calcite and quartz,—that they were conjointly elevated after the upper silurian and prior to the lower carboniferous period, that they formed islands in the lower carboniferous seas, upon which limestones, sandstone, shales and conglomerate, were deposited. The crystalline rocks which have been examined, are thus brought into relation with the auriferous rocks of Nova Scotia. The syenites, (diorites and hornblende rocks?) are correlated with the granites; the argillites, serpentines and marbles with the argillites, quartzites, schists, and ironstones. Cape Breton is thus considered to have a greater extent of metamorphic lower Silurian rock than geologists have heretofore been disposed to concede to it, and of a character which may in no small measure compensate for the probable limitation of auriferous deposits.

Art. II. On the Eagles of Nova Scotia. By J. Bernard Gilpin, B. A., M. D., M. R. C. S.

(*Read November* 11, 1872.)

Having, in pursuing the subject of scutellation on the tarsi of rapacious birds, been led to examine many eagles lately in this Province, I have thought a short description of the known eagles inhabiting it would be acceptable to the Institute. Although we have a greater variety of Brown Eagles of various shades, or, as they are termed, Gray Eagles, than of any other colour, yet all that have come under my notice may be referred to two species and their young: the eagle of the old world, or the Golden Eagle, and the White-headed or American species. Although many of the brown ones resembled, and even excelled in size the Washington Eagle of Audubon, yet their bills and feet so exactly corresponded to the White or Bald Eagle, that I had to refer them to the young of that species.

Aquila chrysætos, (Linn., Richardson, Sclayter.)
Aquila canadensis, (Linn., Baird.)
Aquila fulva, (Temminck.)
Aquila antiquorum, (Cuvier.)
Ring Eagle and Ring-tailed Eagle of Wilson and various European authors, being the young.

This noble bird is rare in our Province; perhaps six specimens may be all I have studied. The late Dr. VanBuskirk kept one in confinement several years. Mr. Downs had a pair trapped in the Eastern Counties. I saw two mounted specimens at St. John, N. B.; and Mr. Egan mounted a very fine one, killed at Pictou by a woman. The adult bird is easily distinguished, and in the young the feathered tarsi, absence of scutellation on the tarsi, paler colour, and less robust, or as it were, less fatty look of legs and toes, distinguish it from the young of the bald. The most distinguishing mark in those I have seen was the prolongation of the loose feathers or hackles from the front and sides of the head to the shoulders. These, tipped with pale golden, and semi-erect, gave the bird a handsome crest, and added much to the intrepid look and stern eye, brow, and well curved, well hooked beak. The other parts were deep liver brown, the primaries black, and the shoulders rather lighter than the back. The tails had always more or less of yellowish white on the lower surface, making an indistinct crescent, its head towards the vent. In this they resembled Bewick's beautiful wood-cut of the Ring-tailed Eagle. The whole plumage was closer and finer than the bald's, the motion quicker, usually in short jumps, with less of that side to side walk, with head pushed forward, tail kept off the ground, and wagging, that the bald indulges in.

The young of this species are described by various authors as being more or less light ferruginous, with white marks and blotches upon the tail, which marks form a white crescent, but disappear with years. In Mr. Egan's specimen there was no white on the tail coverts, and none beneath, or any crescentic marks, but there was a little ash colour inside of the thighs. The one kept by Dr. VanBuskirk showed great ferocity. It attacked anybody approaching it, striking their legs and ancles with its talons. Unless you had a stout stick in your hand, your calfskin boot would soon be ripped from your ancles. This same bird pounced upon and seized a large tom-cat that was attracted under his perch by the fragments of meat dropped about, and immediately devoured it, paying not the slightest heed to its frantic cries and desperate contortions. In its austere, intrepid eye and brow, with swelling and golden crest, it far exceeded the Bald Eagle.

Mr. Winton, who has taken a pair by trap, thinks they breed in the Eastern counties. The best ornithologists of the day consider this eagle common to the Northern parts of Europe, Asia and America, and under the name of Golden Eagle, to include the various synonyms of King and Ring-tailed Eagles, Fulvus Eagles, and Eagle of the Ancients.

The Bald Eagle.

Halieatus leucocephalus, (Linn., Baird.)

This fine bird is common to the Province, and breeds in our secluded forests and rocky coasts. But it is so often seen in its immature plumage, in which it has been confounded not only with the last, but also with the Sea Eagle of Europe (H. albicella), that I think it best to study its various immature plumages before giving the adult. Systematic writers have also concluded that Audubon has not succeeded in making a true species of H. washingtoniensis, and that it is only the young of this species.

The prevailing colour of the smaller of a pair shot upon the grounds of Wm. Cunard, Esq., was dark sepia brown on back, head, neck, breast and lower parts; the brown a little lighter on shoulders, and still more so on the tail coverts, which were somewhat soiled or splotched with white; tail above dark brown, beneath the same, except the inner vanes, light brown, and the inside of the tail feathers becoming white as they entered the vent, which was also white. The long brown feathers covering the thigh had a little white. The chin and throat were white, well streaked with brown. All the loose feathers or hackles covering the neck, both back and front, were white inside, with black tips, but it was only on the front that the white showed through, the back showing brown. The primaries and secondaries were dark brown, and there was a good deal of white inside the wing, the bill bluish black, the cere yellow, and irides brownish. The bill was less rounded in its contour, shorter, and with less elongated hook than the adult. The legs were bright yellow, very robust, with a thick, fatty look. There were five large scales upon the front of the tarsus, five upon the inside toe, thirteen upon the middle, eight upon the outside, and five upon the back one ; the rest of the leg was reticulated or rather covered by roundish small scales. The claws were long, sharp and black, and the soles rough with warty protuberances. The mate of this bird, which was shot almost in the act of striking a peacock, and with the remains of a pullet in her stomach, was larger, and differed in having the tail coverts white, the tail on the under parts turning white, the body darker, and the bill turning yellow, with the beak elongating, and curve finer. Thus, here were two immature birds, the one a little advanced of the other in plumage and bill, mating together. In another specimen put up from a dead horse at Steele's Pond, I found the plumage a light clay brown, but otherwise resembling the others, the irides were brownish, bill black-horn colour, cere yellow. The very great size, the extended wing, nearly eight feet, the tail in the dried state fifteen inches and a half, and the whole bird three feet one inch, and exceeding an adult by six inches, (all these dimensions except the first being from the dried bird,) made me think I had found the lost *H. washingtoniensis*, but the bright yellow feet and robust talons, though differing slightly in their scutellation, so exactly correspond with those of the adult bald, that it left no doubt of its place. On the third moult, that is in the fourth year, these birds, though breeding in the second year, assume their adult plumage. The head, neck, and tail are now pure white, the other parts deep liver brown, with the edge of each feather paler, giving that fine imbricated look to the plumage. The bill has changed from bluish horn-black to bright yellow, its beak lengthened and contour rounded with a slight notch on the upper mandible, and the irides a wine yellow. The bright yellow robust legs and talons remain the same. This is the bird one meets not seldom on the rugged shores of the Bay of Fundy, perched upon a high overhanging dead pine. He boldly stands your approach, lazily floating away as a branch of the withered limb comes rattling down from his strong grasp. He is a fishing eagle, and always found upon the sea coast, or near waterfalls on the inland, though he will eat carrion.

I was riding one morning among the pleasant hills of St

Clements, when most protracted screams filled the air. Looking above I saw an osprey or fishing hawk loaded with a fine large fish, upon whose back a bald eagle was making stoop after stoop, soaring up after every strike and striking again. Presently the fish tumbled out of the osprey's claws and came skimmering down flashing in the early slanting sun rays. The eagle folded his wings, dropped like lightning below the fish, and turning upon his back caught it, whilst the poor hawk disappeared screaming.

Though Wilson gives instances of this bird carrying off lambs, and in one instance a child, there are no traditions of such daring in this Province. His favorite food is fish; he strikes them alive, but will accept them dead; and we see him on this pursuit watching from a blasted pinethe receding tide, or beating the long half dry flats of the Bay of Fundy. Our largest specimen was put up from a dead horse lying on the beach. They are usually in good condi tion, and no doubt the plenty of rich food, varied by hares, squirrels and grouse he obtains in the forest, prevents him from turning his yellow talons on lamb or child. They breed both on trees, and in rock cliffs. This last fact, verified by Mr. A. Downs, seeing them clinging to the cliffs in Grand Lake, is of note, as Mr. Audubon claims this as distinguishing his *washingtoniensis* from the balds. Though as long ago as Wilson, it has been determined that the brown eagles turn into balds in the fourth year, yet it is pleasing to verify it ourselves, to see the different colours mated together, or to watch them in confinement putting on the adult colours in the fourth year, as we have done in the gardens of Mr. Downs, and Mr. Leahy. As a sure test in determining our young specimens, and preventing them from being confounded together, or even with the *albicella* or Sea Eagle of Europe, which occurs in Greenland, (and a strong tempest driving one here may occur,) the scutella or large scales on the feet and toes are the best tests. The Golden Eagle has none on the legs, and about three on each toe, the bald eagle has usually five on the leg, five on the inner toe, from eleven to thirteen upon the middle, eight upon the outside, and five upon the behind toe. These vary especially upon the middle toe, and upon the leg; but a series of perhaps thirty gives this approximation. The greatest variation occurs upon the tarsi on the leg, and though nearly every specimen has five lateral scales upon the front yet in some they are so small and obsolete, that they have to › looked for, whilst in others they are very large, and extend nearly to the joints of the front toes, as in Audubon's figure. This diffe rence is especially to be noticed, because Audubon makes "scutellation on tarsi and toes continuous with their length," a specific mark of his great Brown Eagle *H. washingtoniensis*, and he figures it so in his great work. Subsequent writers as Cassim and Baird have denied that it can be so, and indeed one cannot get over the anatomical fact that no great scales can cover a joint, or that the hind toe, if even the three front ones might, would be incapable of a continuous scutellation; yet we have a satisfaction in showing, I think for the first time, a very marked approximation to Audubon's figure. As regards the other specific marks of the Washington eagle,—of his folded wing not reaching to the end of his tail,—of his nesting in cliffs instead of trees, our young balds possess them both.

16th June, 1873.—I examined a young bald. I supposed it to be about two weeks old. It was covered with thick yellow down. The primaries, secondaries, and tertiaries in pin feather, and about two inches long, were sepia brown with lighter tips. The spurious feathers were also showing. There were three or four dark spots on the back, and the tail feathers just showing, all the rest yellowish down. The legs were pale yellow; there were twelve scutellæ on the front of the tarsus, about twenty on the middle toe, and the back of the tarsus was also scutellated. The bill was yellow tipped with black on both mandibles, but the curve little developed and resembling that of the turkey buzzard. The length of the body from tip of bill to tail, eleven inches, and thigh and outstretched leg to toe eight inches.

This bird was sent me from Digby county by my son. The great development in number of the scutellæ and their appearance upon the back of the tarsus, in what may almost be called the embryo, and also the striking resemblance in the head and bill to the carrion buzzards, are both prominent facts in regarding scutellation as temporary and non-typical, and also in Agassiz's theory of the young resembling the next lower type.

In conclusion, I have met only two eagles inhabiting the Province, the Golden Eagle, the *aquila antiquorum*, the bird of Jove, of Cæsar, the type of the white, red, black, and double headed Teutonic family, and of the first Napoleon; the second or Bald Eagle, our great neighbour has adopted as their symbol.

We may say that the old world having first choice has the finer bird, yet a great maritime country is well symbolised by a Sea Eagle; and Nova Scotians may well say, glancing at our plundered fishing grounds—a fishing one.

Art. III. The Great American Desert. By Henry S. Poole Esq., F. G. S., &c., *Govt. Inspector of Mines.*

(*Read Jan.* 13, 1873)

A popular lecturer recently speaking of the Great North-West referred to a map on the wall, and pointing to a great region of country which extends from the parallel of the north fork of the Platte River to the Sierra Nevada, and from the boundary line of British Territory to Mexico, spoke of it as the Great American Desert. To the immigrant pushing across the continent to the golden state, California, it formerly doubtless did seem to be all desert. For after leaving the rich loomy soil of Illinois and Iowa, and the rolling prairie of Nebraska, bright with many-colored flowers, he entered on a region which grew more and more desolate as he advanced towards its centre, and yet he seldom found any of it so poor but that it afforded sufficient nourishment for his cattle, and enabled him with their aid, after many weary months of incessant toil, to reach his destination.

But it is not to that immense region, now better known, and no longer spoken of as *the* desert, that I desire to draw your attention. It is merely to a portion of it that lies nearly in the centre, and forms but a small part of the whole of the country. Without doubt there are in the region referred to by the lecturer, besides the desert that is a desert beyond question, extensive tracts of most desolate and forbidding looking country, as equally ill adapted for cultivation as the saline plains of the Saskatchawan, or a Bay of Fundy mud flat at low tide. Still as there are many fertile valleys among the mountains naturally well watered, and many extensive plains that need only irrigation to make them blossom as the rose, the term Great American Desert has become restricted to and is now only applied to that comparatively small district, which lies immediately to the west and south-west of the Great Salt Lake in Utah Territory. The northern border of this region is skirted by the Central Pacific Railroad; but before the trans-continental traveller from the east becomes acquainted with its dreary expanse, he has to traverse the passes of the Wahsatch Mountains, where his attention is drawn to the bold scenery of Echo and Weber Cañons, and where as he scans the rugged sides of those passes for glimpses of the picturesque spots, or for unfamiliar views of towering crags and overhanging precipices, he will perchance as he nears Ogden (the junction of the Union and Central Pacific roads,) notice horizontal and parallel lines more or less distinctly marked on the sides of the Cañon. These lines on a nearer approach are seen to be made of wide "beaches", or, as they are locally called, "benches" of gravel, which having a gentle inclination plainward extend in a series of terraces from the foothills of the mountains to the bed of the cañon and margin of the lake. The attention once called to this peculiar feature of the landscape, the eye naturally wanders over the wide view which is presented when the valley of the Great Lake is reached, for further confirmation of the well known theory which their appearance calls to remembrance :—that they are the "beaches" formed by the lake when its waters stood at a much higher level than they do at present.

Through the clear air the continuations of these horizontal lines are seen for miles girdling the mountain sides and the rocky islands in the lake. The more this feature of the landscape is considered, the more conclusive does the evidence seem that each terrace marks the position at which the landwash of the great sea once stood, and that the present lake, large as it is, is but the remnant of one a hundred times greater.

But it is on the borders of the great desert where a wider range gave freer scope to the ancient winds and storms to stir up the waters of the lake, and scour its shores, that a remarkably well defined beach is most plainly visible. Of so recent a formation does it appear to be, when seen from a distance, that it forcibly reminds the Nova Scotian of the wide beaches and broad spread detritus that surround the islets and headlands of the Bay of Fundy. This desert and its neighbourhood greatly interested me, on account of its peculiar physical characteristics and distinctive features.

From Salt Lake City the most direct trail west skirts the southern margin of the lake, passing close by some hot sulphur springs that bubble up in the fine loomy mire of its margin, by the foot of the Oquirrh Mountain range, where the waters of the lake wash the only stretch of beach to be met with on its southern and eastern boundaries, then along a natural causeway which curves across the flats of Tooelé valley and is evidently the remains of a former beach ridge, similar in character to the "boar's back" of Cumberland county, only that it is composed of finer materials—gravel and sand. At the head of the valley ten miles distant, at an elevation of 600 feet above the lake, a very much heavier bar exists entire, which damming back the natural drainage of Rush valley forms Stockton Lake, a lake of fresh water. The trail then skirting the promontory of the Onaqui Mountains, turns south up Skull Valley and leads by a gradual ascent to the divide on the mountain range which overlooks the Great American Desert. From this point at an altitude of 1800 feet above the plain, I obtained a view of exquisite grandeur. At the foot of the steep descent lay the desert, spreading far and wide, with patches of snow on its surface, reflecting, like pools of water, the rays of the setting sun. Immediately in front and apparently at no great distance, though nearly eighteen miles off, the Granite Mountain, the camping ground for the night, lay alone in the desert. Beyond it were the low-lying ranges which border the desert on the west, and further on the Mountains of Nevada. To the right, more than one hundred miles away, the high peaks of Southern Idaho were visible, beyond the northern boundary. But the mind, bewildered by the vast extent of the vista, could hardly direct the attention to localize the unfamiliar objects, before a low-hanging cloud, its upper surface as it were spray of great waves, dashed by the tempest against the mountain islands and frozen at the instant, rapidly approached, obscured the plain and changed the scene like a dissolving view. This picture was but of short duration, for the cloud quickly advancing soon enveloped me in its misty folds, and left nothing but an ill-defined view of plain and looming mountain visible.

From the Granite Mountain the trail speedily leads to the lowest part of the desert, where no grease-wood or even sage brush grows, and where the mud baked in the dry season glitters with its salt incrustation. Like the sediment on the banks of the Avon it separates into thin layers, but when wet from recent rains is as adhesive and slippery as mud well can be, balling horses' feet much worse than the damp snow does here in the month of March. This mud has a perfectly level surface, and occupies the lower portion of the desert. As the shore of this dried up sea is approached, a gradual though all but imperceptible ascent being made, the character of the detritus from being fine clay becomes more and more sandy; and the sand not baking on the surface as the mud of the interior, gets blown during the dry season into hillocks, and little mounds round each clump or isolated sage bush. It also takes the form of long ridges stretching from point to point at the mouths of bays, or encircling the quondam islands, often many miles from their base, presents the character of sand bars, having gradually sloping faces seaward, and with steep declivities landward, shuts off what must have been immense lagoons from all but slight connexion with the outer sea. A bar of similar character now separates the desert from the high water line of the western shore of the great lake, and as the elevation of the bed of the desert cannot be many feet above the surface of the water in the sea, there may be some truth in the Indian tradition, that long ago the greater portion of this region was permanently under water. It is well known that, after heavy winter storms, wide sheets of shallow water stretch for miles over the desert. Dammed back from the lake the water can only pass off by absorption, or evaporation. It has been shown by comparing the records of a series of years that the level of the great lake varies.

From the accounts of the early settlers, it appears that the amount of rain-fall largely increased from the time of their first arrival until a year or two ago, when a retrograde decade commenced. They affirm, that during that period the level of the Great Salt Lake rose as much as nine feet, above the height it occupied at the time of their first advent into the valley; and also that in consequence of the increased precipitation the waters of the lake became less saline, in the proportion of 3 to 7—a proportion determined by the quantity of water required to yield the same amount of salt in the pans. As a further confirmation of their statement, they say that the islands in the southern end of the lake could, in early days, be reached on horseback, while now they can only be gained by boats.

A very interesting "tide guage" is to be seen, in a mound on the edge of the lake opposite the village of Bountiful. At the present day only the top of the mound is above water, but ten years ago the edge of the lake was so far from it that a settler thought the surrounding land could be sufficiently drained, and otherwise prepared for crops. He consequently began to cut drains and break up the soil by ploughing and deep trenching, hoping in three years or so, to find the surface sufficiently washed from salts to allow of his planting wheat and corn. His hopes were disappointed, but in ploughing over the top of the mound, he turned up fragments of rude pottery, and a stone similar in shape to the hollowed stones now used by the Arapahoes and other maize-growing Indians of the present day to bruise their corn. Similar mounds were cut open in building the Utah Central Railroad through the valley. It would therefore seem that when the sedentary tribes of Indians, who inhabited the valley previous to the incursion of the Piutes and other predatory tribes, who occupied it on the arrival of the whites, the level of the lake was even lower than at the time when the Mormons first settled the country. That the Salt Lake is not altogether lifeless has been recently proved by the discovery of a crustacean—*Artemia salina*—in its waters. The species is very similar to that found in the salt pans of Europe.

Returning to the desert where we left the trail, to consider the variations of level in the lake, the old overland stage route, after passing the outlying belt of sand hills, traverses the ancient beach, which starts from the mountain side fully nine hundred feet above the lowest part of the desert, and extends seaward, if I may so term it, for as much as four miles in some places, before the gravel gives place to sand, and for many more miles before the region of salt mud and utter desolation is attained. The whole face of the beach shows evidence that many periods of cessation took place, during the subsidence of the waters. In places, sections of the materials which compose the beach are shown: beds of fine white sand partly cemented, lie interstratified with beds of coarse gravel. In sheltered ravines I have counted eighteen bench lines within an elevation of two hundred feet. In other and exposed places the sloping faces would be of great length, and represent an elevation of one hundred feet or more between the lines of change of grade, as round the points of the old promontories, and in positions parallel to the general course of the plain and valleys. These wide benches would seem to mark the more permanent stages in the general subsidence, and the numerous lines seen in the better sheltered bays, to point to intermediate stages of shorter duration, which on the exposed shore became obliterated by the fluctuations of level in the lake, and by the wash of waves during storms. Again in large land-locked bays, as the present Camp Floyd valley, where a stretch of country twenty-five miles long, by eight wide, has the range of mountains lying parallel to the line of drainage; there a uniform slope of about seventy feet to the mile is seen without any bench lines or divisions into terraces, except it may be round the mounds at the base of points of rocks, and outlying foot hills.

These benches, indubitably prehistoric beaches, cannot fail to be noticed in others of the low-lying valleys of the country known as the "great interior basin," and which includes all Nevada and half of Utah; an area of at least 150,000 square miles. Besides the prominent benches, noticed by every one, a close inspection in certain districts of the region reveals indications, not very distinct, but suggestive of doubt whether the ancient sea did not extend to even a greater altitude, than where the well-marked terraces define its sometime boundary: a doubt which further attention to the subject almost changes into a belief. The old overland road after leaving the desert, and before entering the confines of Nevada, crosses the Deep Creek, which flows through a narrow elevated valley, on the sides of which at an elevation of 1800 feet above the lake, great beds of gravel uniformly deposited, and evidently by water, have the same parellelism which is so discernible in the valleys opening into the Desert and Great Salt Lake. The lines of level which elsewhere cannot fail to catch the eye, are here through time almost obliterated, and can only be detected when viewing an extended range of country.

What has been the origin of these gravel beds? For beds of a similar character are also to be met with in many other elevated valleys. They are evidently not fluviatile. Are they lacustrine; or can they possibly be marine? Lying as they do truly horizontal, it is highly improbable that they can be marine, and were formed when the mountain ranges as islands were emerging from the ocean. Were this possibly the case, then the whole of that country lying between the Wahsatch and the Sierra Nevada must have been bodily elevated 6,000 feet without tilting or breaking in any degree the uniformity of these superficial deposits. And yet if the valleys of this elevated region were not filled by the action of marine denudation, we are forced to conclude, improbable as it may at first seem, that they were by subaërial agency, and that the agent which formed the benches was a lake of fresh water.* A lake which must have extended over the major part of the greater interior basin, and have had its surface at one time, nearly, if not quite, 2,000 feet above the present level of the Salt Lake. It is

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* In digging a well near Salt Lake City, fresh water shells were found some forty feet below the surface in the gravel deposits, and on the north side of the lake, the cuts on the railroad, through the gravel and sand, reveal the greatest abundance of fresh water shells. The species that seem to have been most abundant is *Fluminicola fusca*. Varieties of *Limnea*, *Valvata* and *Amnicola*, were also discovered.—HAYDEN.

hard to contemplate what physical changes must have taken place in the adjacent regions of the continent since the earlier days of the present epoch when this immense lake existed, so to affect the climate of a country which for a lengthened period undoubtedly was humid, but is now arid for at least the greater part of the year.

It is evident that for countless ages this great inland sea existed, and receiving the detritus washed from the shores of the numerous chains of islands studding its surface, distributed it according to the size of the particles in the valleys adjacent; carrying the fine sediment to the centre of the valleys, and leaving on its shores the coarser material to form the gravel benches which now belt the mountain ranges. The thickness of these deposits is as yet undetermined. The deepest wells yet sunk have only reached a depth of two hundred feet, and merely show that the materials composing the benches are not all uniform in size. Beds of coarse gravel give place and alternate with beds of fine gravel and sand. Here and there through the deposit, boulders of stone record the existence of ice at times in the days of this ancient lake. The action of ice, probably in the form of glaciers, is also recorded in the well rounded stones found in the gravels of the most elevated valleys, which stones have been fractured and re-cemented together, as are those of a similar character found in the terminal moraines of existing glaciers. From the great width of the main valleys and the precipitous sides of the mountain ranges, I have little doubt but that the bottoms of the valleys were originally much below their present position, and that they have been filled in with detrital matter to the depth of many hundreds, if not thousands of feet.

An apparent further confirmation of the great altitude which the surface of the lake attained in former times is to be seen at Bingham Cañon on the east side of the Oquirrh Mountains, where at a height of 300 feet above the present bed of the cañon and close to the town, a portion of the old bed remains on the side of the mountain. This bed had a steep descent towards the plain, and yet became choked with great water worn boulders of the country rock. In the clay and with the fragments of quartz veins which fill the interstices between the boulders much of the gold which gives Bingham its celebrity as a mining camp, is found. It is just probable that when the highest benches along the foot hills were formed, they acted as a dam at the mouth of the canon, on the free discharge of the mountain torrent before the general subsidence began, and the old bed became choked with the great boulders which now fill its course.

It is interesting to note that nowhere in all the region of the great interior basin are there any outlets for the drainage of the country. All the moisture which falls is carried off by evaporation. It is supposed by some that there was an outlet for the waters of the ancient lake by the Snake River Pass into the channel of the Columbia River, which flows through Oregon into the Pacific. Whatever may have been the destination of the water in old times, the Great Salt Lake is now the receptacle of all the drainage of the North Eastern portion, while other smaller lakes or sinks terminate the existence of many torrents that rush impetuously and in great volume from the mountain gorges in other sections of the country. Generally these mountain streams flow but a short distance after leaving the rocky bed of the cañon before they are totally absorbed in the deep alluvium of the plains. Some, however, do flow into perennial lakes that are either alkaline or saline; but to sink in a morass is the general destiny of a mountain stream.

Springs also, which in certain districts are numerous, and often of great volume, give rise to streams that originate only to share the common fate, and be lost in their immediate neighborhood. Sometimes these springs burst up in the plain several miles away from the base of the mountains. Those of pure water frequently swarm with fish—mountain trout and suckers. From some the water flows hot, and charged with sulphuretted hydrogen; and from others cold, and contaminated by contact with the alkaline soil through which they rise.

The scarcity of water in this region contrasts strongly with the numerous brooks and rivers we find intersecting this Province in all directions. Water there is a marketable commodity, and is sold either by the inch or hour. It is an object of first consideration to the freighter slowly journeying over the country, to the farmer striving to make a moderate income from the natural fertility of the soil, and to the miner desirous of the aid of steam to help him extract from the mine his expected fortune.

The scarcity of water restricts the growth of timber to certain districts, and explains the application of the term "treeless wastes," which has been applied to the plains.

In summer, showers are of much more frequent occurrence on the mountains, and fall much heavier on the timbered ranges than on the foothills and valleys. In general a summer storm which drenches the mountain sides affords but at most a gentle shower or temporary shade to the treeless plain. Even the snows of winter fall lightly on the plain, while storms almost daily rage among the peaks of the Wahsatch. Looking at any mountain range, it will be noticed that the Southern slopes of the spurs, parched by the rays of a constantly blazing sun, are utterly barren, while the opposite sides, having a Northern aspect, are heavily clothed with timber. The dark shade of the pine trees deepens the shadows cast in the ravines, and heightening the contrast, throws the crests of the mountain spurs into greater relief.

Wherever in the valleys there is a constant supply of water, trees will grow, as they naturally do along the courses of the streams or artificial irrigation ditches. Again on the foothills clumps of cedar grow wherever springs, which may not even show themselves at the surface, keep the ground moist. I lately referred to the enormous quantity of detrital matter which torn from the mountain sides had been ground down, comminuted and carried off into the depressions between the ranges until it had filled them up and made the present great stretches of plain and valley. The period of time necessary to produce changes so extensive must at least have been great if not incalculable. The very changes themselves would produce such modifications of the surface as to bring fresh elements into the calculation, and reduce the most careful estimates to but wild guesses.

Besides the silting up of the valleys other evidences remain to show the extent of the denudation. Even on the mountain sides there are monuments to point to the wear and tear due to the elements. Castle rock and Pulpit rock in Echo Cañon, and the "red buttes" on the plains of Laramie, are some of these.

Pinnacles also, either isolated or arranged in groups, stand out of the rounded hill side or denuded plain, and resemble the roches perchés on pillars of ice on the great *mers de glace* of the Alps. Professor Tyndal has clearly explained how the blocks of stone became perched on pillars of ice on the surface of the *mers de glace*. Similarly these pinnacles capped with blocks of sandstone, more compact and less friable than the conglomerate that composes their shafts, were doubtless formed.

The harder and more enduring blocks of sandstone, fragments of an overlying bed, have protected the more perishable red conglomerate from the disintegrating action of the heavy rains, while the general level of the country was being reduced; and these pinnacles remained to mark its position in times gone by.

Another interesting record similar in character to that preserved by the "red buttes" is the Devil's Slide, as it is called, in Echo Cañon. Two parallel dykes of syenite some four to eight feet thick and close together, rise abruptly to a height of twenty feet above the surface of the mountain side.

The extent of the effect of the subaërial agents on the constituents of mineral veins, in this region, furnishes still more conclusive evidence of the great period of time which has elapsed since the waters of the great lake receded from their more elevated levels to their present position.

In the beds of certain of the cañons and on the mountain sides where the strata are of such a nature as to retain the water, there we yet find even at great elevations the constituents of the lodes as sulphurets. But where by natural channels the water absorbed by the ground in the wet season is allowed to drain away, the warm air, containing of course carbonic acid, which filters in, has an opportunity to act on the mineral substances contained in the vein, decomposition is set up and oxidation of the sulphurets takes place in a degree proportionate to the facilities offered by the structure of the vein, and the tendency of the minerals to decompose under such circumstances.

Now since even down on the foothills, the outcroppings of galena lodes are found to consist of cerussite, with here and there a nucleus of galena, the purity of which has alone effectually resisted the slow combustion which the favorable conditions for the admission of moisture, warmth, and air, have established in the vein where the more easily decomposable iron pyrites are intermixed with the galena, we are forced to conclude that a considerable length of time must have passed away since these veins were first exposed by the subsidence ot the lake to the action of the agents of the atmosphere, to allow the decomposition to extend to the depth to which by mining, it is often found to have gone.

In the veins in the limestones of Camp Floyd and Lyon hill, the outer portions are found to contain chloride and chloro-bromide of silver, which in depth give place to ruby silver, and at still greater depths, to sulphides and antimonial silver ores. The limestones being open have allowed the action of the elements to transform the sulphides and antimonides into oxides and chlorides of silver, even to a depth of one and two hundred feet.

The Jordan property, the oldest location in Utah, has enormous deposits of carbonate ore, averaging 60 per cent. in lead, cropping to the surface, which in depth, as soon as water is struck, gives place to unconverted galena. As much of this galena is largely mixed with iron pyrites, which the decomposition in the upper portion of the vein changed into sesquioxide of iron, a base rather beneficial than otherwise for the reduction of the ore in the blast furnace, the value of the property which the appearances on the surface indicated is greatly reduced.

The ores from the great Emma mine also supply excellent examples. The specimens on the table show all the stages of change. The nucleus of each nodule being either of galena or of undecomposed sulphoantimonide of lead and silver, is encased by partially oxidized compounds and carbonate of lead and oxide of silver.

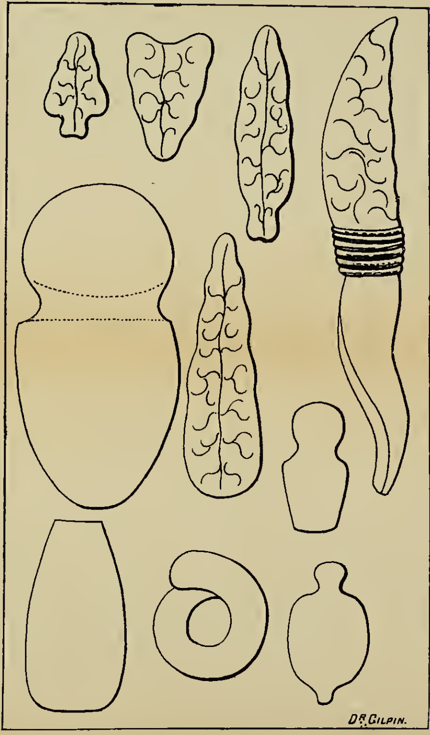
I have here a very interesting mineral, the remains of a rodent encased in lead ore. It was found in the Silver Exchange on Lyon Hill. The country rock there is limestone; and fissures penetrate it to a considerable distance. The animal, probably a ground squirrel, to which this portion of a lower jaw belonged, must have found its way into the fissure to die, or the body must have by some means been carried in, previous to the washing down of the lead ore from higher levels, or before the waters carrying the lead in solution precipitated it on these remains. A mineral vein is a most unusual position in which to find organic remains; and the modernness of these clearly demonstrates the changes which mineral veins are subject to under the favorable conditions which this region presents.

ART. IV. ON THE STONE AGE OF NOVA SCOTIA. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.,

(*Read Feb.* 10, 1873.)

WRITERS upon the Stone Age of the old world know nothing of the habits, the manners, not even the forms of the prehistoric men who fashioned those stone axes and celts, (almost their only record) which have of late excited so great interest. The age of Bronze is a myth. The age of Stone has swallowed every myth in its fabulous antiquity. Not so when we study our own stone period. We know from contemporaneous writers their forms, their habits, their clothing, their wars, their peaces; we can bring to the mind's eye the brown hands that toiled over pointing an agate, or ground down the edge of an axe,—the dusky red man who fished the short summer, hunted the long winter, eat of no bread, asked nothing of the fair land he lived in, but shelter for his game, and its profusion of wild berries which it cost him no toil to gather.

Among the gentlemen who followed DeMonts in planting in the year 1603, the French colony at Port Royal, now Annapolis, Nova Scotia, was LesCarbot. From an old and rare translation (London 1712,) of his original work published 1607 in France, from the library of T. B. Akins, Esq., I quote the following particulars of the habits of our Nova Scotian Indians, at the period of 1603, now two hundred and seventy years gone, and what may be called the end of their stone age. When it began, we can scarcely conjecture.


DR. GILPIN.

Our Indian was clothed; he wore a waist belt of leather prepared from moose or caribou skin, an end or flap of which passed between his legs and fastened behind; over this was a cloak of skins, tied by a leather thong about the neck. In camp he usually cast this cloak off, and went with one arm bare. Neither sex wore any covering upon the head, and the woman was clothed alike, except that a belt kept her cloak tight to her figure. When exposed on the water, or hunting in the snow, he put on long sleeves of skin, fastened to each other by a thong, and long stockings of the same, reaching and tied to his waist belt. These "hosen" were ornamented on the outside by tags of leather. These tags or fringe is the universal ornament of the entire continent, seen in the present suits of the Rocky Mountains, and found in the selvaged and scarlet edge of the blue cloth stocking of our day. The custom of tying the fur mitten about the neck is still preserved by the Labrador settlers, though lost by the Indian. Stout moccasins complete his dress. His wants were simple: food, shelter, and defence. The easiest obtained food was fish, consequently he fished eight months of the year on the sea-coast. Smelts, herring, shad, gaspereux, salmon, trout, and eels, were taken, by damming the rivers with stone and wooden dams, and leaving an opening through which the fish in passing and returning from spawning must pass, and be taken by spearing, or in a basket. Shell fish always furnished an inexhaustible supply. The ocean fish were taken by bone hook, though already the steel hook was beginning to supplant them. When the winter drove the fish to deep soundings, then his food was the flesh of moose, caribou, bear, beaver, with the smaller game of hares and raccoons. In moving from the sea coast to the interior forest, he needed some vehicle to transport his few properties; the skins and bark for his wigwam, his rude pots, his bows and arrows, and weapons of defence or the chase. The canoe built of birch bark was always on hand. (A smaller boat of platted willows covered with gum seems to have been lost out of all tradition.) His shelter, his camp or wigwam may be seen unchanged at the present day, with its poles drawn to a top centre, its covering of bark, and its spreading circle below, or in the rude circular stone walls which may still be seen standing on the stony beaches of the Bay of Fundy, and looking as if they had stood there three hundred years. For defence against his enemies he made a stockade, that is he lashed the boles of contiguous trees together in the form of a square, thickening them with branches and other poles, and raised his wigwams inside the square. For defence of his person in war, he bore a shield doubtless made of wood and skins, and carried a bow, strong but not very fine, on his back, with a quiver filled with long polished arrows feathered with eagles' feathers, and a war club in his hand.

Two hundred warriors naked to their waist belts, thus armed stepped out before LesCarbot in dancing measure at St. John River. They had come from Gaspe at the command of Membertou the great Annapolis Sachem, to join the St. John Indians, and his own people in the war they were waging with the tribes beyond the Kenebeck. It is singular there is no mention of scalping in this narrative. Before this, LesCarbot saw them hunting the moose with bow and arrows alone, and in all his narrative there is no mention of spears or javelins, though we find abundant stone heads still. The use of tobacco was universal, using shallow stone pans with quills and reeds stuck in them. This they must have obtained from the tribes west and south of the Kenebeck, as they planted none themselves. There was no planting east or north of the Kenebeck, not from ignorance but rather from idleness as LesCarbot tells us. They ceased to plant, and to make stone clay pots, when they could obtain kettles and biscuit from the French traders, in barter for furs.

With the use of tobacco they had also almost consequent to its use, the power of making fire, at all times and places. The dry punk and the bit of agate was always theirs; but it is probable that the steel and the art were got from the French, who had traded full fifty years before at Canseau. LesCarbot is silent about it. They taught the willing French the use of tobacco, who used it to excess. Thus at the dawn of the iron age in Nova Scotia, we find our stone age man a comely, fairly fed savage, clothed,—a fish and flesh eater,—no toiler of the earth, eating only of that luxuriant berry harvest, to which all our carnivori still hasten, not excepting Saxon man himself, and which seems almost spread as an antidote to the non-bread-eating man. We find him a man without a house, or key to his front door,—no dweller in cities, save when danger sent him within a stockade of living trees thickened by interwoven branches,—observant of the marriage tie, but with no strong sense of chastity, or feeling of jealousy. Of religion in its modern acceptance he had none; some indefinite belief in a future, acting in no way on the present, and a few medicine men, and soothsayers, was his creed, and his church.

In cooking he had arrived to the point of boiling, making pots of pine and birch bark, hooping them about to enable them to hold water. The water was heated sometimes by throwing in hot stones, at other times by kindling fire beneath: no doubt the bark saturated by boiling vapour resisted the fire. He also used coarse clay pots. As regards his other fare one who has had the good fortune to camp with them in the forest, would see the same process going on before him as their tribes used two hundred years ago. Fish impaled on forked sticks and stuck in the ground about the camp fire; the entire entrails of a porcupine festooned on forked sticks, and roasted till they cracked asunder; whilst the marrow bones of a moose were cracked as perfectly, and the marrow roasted as nicely as ever prehistoric Dane did it in the mythic times of kitchen-midden.

In Newfoundland they boiled eggs to hardness, pounded them to flour and preserved for winter, certainly a hint for modern science in preserving concentrated food. He had not risen to the art of making alcohol, one of the most universal, as well as the first acquired arts of man; nor to letters. He was courageous, liberal in giving, and kind and happy in his domestic relations. "There be some families," saith LesCarbot, "that had they not been Pagans, the Lord would have entered in, and dwelt among them."

For the form and feature of our prehistoric man we must draw upon his present descendant living now, almost under the same circumstances as his ancestors. The skull small, but well developed in the frontal regions,—the eye small, slightly oblique, hidden by the brow above, and the high cheek bone below,—the whole frame slighter than the Saxon, with shoulders that would slope (and do in the young and women,) but are from their carrying burdens raised upwards, especially the right. The leg is bowed but very fine, the bend high up beneath the knee, and also like the famed Roman tibia rounding forward. The hands and feet fine, especially the instep of the last. A clay-yellow, slight, active, undersized figure, beardless almost, but with abundant coarse black hair, with intelligent rather than bright eyes, slightly Roman nose, but the nostrils very wide, strong angular jaw, and strong teeth.

Such is the fast fleeting type of our present Indian, and such no doubt was that of our prehistoric man, but with feature and expression intensified by their daily life.

Their daily scramble for food, their hourly fears of enemies or attack, their half clad exposure to the elements, must have all written their marks, now somewhat obliterated in their descendants. The late Dr. Webster, of Kentville, found in old Indian graves so many bones of the fore arm (radius) crooked, that he supposed their shape was modified by drawing a bow.

To the question had not the age of iron come down upon him, had he the power to maintain himself, or to improve his condition? we must answer, the progress would be so gradual, the contingencies so many against him, that he had not arrived yet at any fixed point from which he could not fall back. There is no recorded instance of an inferior race improved by a dominant one. They disappear before them. Many assert they are unable, but it is better to say the progress is so slow that it cannot be measured.

How this Stone Age was conducive to the highest vigor of mind and body, the history of Membertou, the powerful Sachem of Annapolis valley, so graphically touched by the French historian, is a rare record of exquisite beauty.

One hundred years had gone down upon a head on which there was no silver stain; the eye that surpassed the lively Frenchman in seeing at a distance, had had one hundred years of outlook. He loved wine because it made him forget his cares at an age when men have few cares. His active brain was meditating for months and years a war against the tribes beyond the Kenebeck; and he brought his men from Gaspe and St. John River, joining them with his own at a rendezvous at Grand Manan, and himself at that vast age headed a victorious invasion. Though his sense of his own greatness was such as to demand a salvo of cannon when he entered their fort, yet this far-seeing old man saw at once the inevitable end of his race. He accepted their religion, begged to be taught their arts; he had been a great warrior, and a bloody man in his day, and many years brought many enemies; and he said "I sleep sound, I do not fear my enemies near my friends' fort." When the end came to him, with it, as to most men of unabated mind, came the thronging past. This old pagan, but new christian, longed to rest with his old braves; he feared his soul would not receive the consolation from the annual visit of the tribe to the graves of their sires, but he yielded reluctantly to the worthy fathers of Jesus, who knew how little his example would be unless crowned with christian requiem. And so the young christian Henry (so called in baptism after his brother monarch Henry of Navarre), got his bit of churchyard mould with those salvos roaring over him, which he loved in life, and with such as they honored a General of France.

Far, far more befitting, had the old pagan Membertou, glorious old type of the stone age, been wailed in the soft gutteral notes of his women mourners;—had the long procession of canoes, borne him by the light of fires on a hundred hills, to that desolate isle, as LesCarbot says, some twenty leagues away in the direction of Cape Sable,—had his old braves put him to rest in his uncoffined grave, swathed him in beaver skins, shrouded him in birch bark and heaped over him stone axe, agate spear, or jasper arrow-head. This spot lies yet at the foot of the great Rossignol. "Fern clad mounds," (to quote our late member Capt. Hardy,) still mark where the stone men sleep.

In wandering tribes such men mark only their own age. Men must be brought together first, then come laws, letters or recorded law, and the past acts upon the present. Accumulated capital to keep them together, or agriculture, then is the first great step towards civilization—a step which once obtained never goes back. This made the thoughtful remark of Humboldt, "cereals were the bottom of everything." And not having attained this we cannot say whether our stone men would have elevated themselves. Let us remembər that with their dying hand they presented the world with two things, which from their universal use, and from the influence they have excited in the policies, nay, in the very existence of nations, may mark hereafter an age for themselves—Tobacco, and the Potato. The greedy Frenchmen sucked in the new and intoxicating weed till they became insane, and LesCarbot had not seen but heard of a marvellous root like small loaves, hanging even to forty on one root, but of rare flavour.

We have now seen our *men* of the Stone age, let us look for a moment on their *country*. Dense forests crowned the whole Province to the water's edge. Meagher's Beach, the Thrum caps, and Devil's Island, now sandy spits, were wooded headlands to the water's verge. Such an excessive animal life filled the forest, filled the air, filled the sea, nay, even the bottom of the sea, that no one may conceive it, or believe it. The beaver abounded on every stream; the moose came out in sight to browse on the great meadows, which then as now were the great features of the Annapolis valley; sea birds covered the waters and darkened the air; and every spring brought fish innumerable, with their attendant pursuers, dolphins, whales, seals, and walrus, whilst the sands were paved by scallops and clams. Such war as can be made by a stone arrow, or bone hook, did our prehistoric man make upon this army of animal flesh. He seems to have asked nothing of vegetable life save the luxuriant berry harvest, which even yet spreads its purple profusion on our barrens, and whose autumnal stores must have been of incalculable benefit to the satiated flesh eater of the past year.

Again, we often read of dominant races destroying by violence the weaker of the age of Bronze thus dominating over the Stone, by supposition as it were, and to account for these changes. But we read in the history of our own stone men, that there was no violence; that the doom was velvety; if it was inevitable; that it begun with the belly; the Indians ceasing to mould stone pots, when they got iron kettles; and that it was indirect. The first iron axe was laid, not at their necks, but at the wood of the trees; the ploughshare entered not their souls, but the broad breast of the

Province. With the trees went the game, followed soon by the eaters of that game.

Let us leave that godly old Huguenot, Mark LesCarbot's graphic touches, and examine what remains our stone men have left behind them. They have left no mounds; they never could have kept men together long enough to build one. They have left many shell mounds in every part of the Province, but near the sea. These collections of oyster and clam shells mixed with bones of fish, birds, and mammals, have not yet been studied with the care they deserve. They are the collection of ages, and would well reward a thorough investigation. They have yielded to a very slight search, arrow-heads, stone chisels, and handles of moose horn.

Again, we turn up graves which may be called of the transition period. Here the warrior rests with stone and iron arrow-heads mingled. The latter were, some with a socket to receive the shaft, others with the tang elongated and pointed to enter it. Again, we find the stone axe and rusting gun side by side. Thus proving how early the French traders accommodated themselves to the needs of traffic. Another grave was opened at Yarmouth whose occupant must have been a great soldier before the Iron age. Full forty stone weapons of beautiful and foreign work, attested his greatness, and in part proved the tradition of a heavy fight by foreign invaders having there been done. These graves so common about New Jersey are exceedingly rare here. Our usual finds are from the fields and cultivated lands. The plough is continually turning up stone arrow-heads, spear heads, axes, gouges, and chisels; but there are various parts of the Province more fruitful than others. A great many are found at Yarmouth, apparently of stone not found now in the province, and of a different work. Annapolis, especially about the tide waters of the LeQuille River, perhaps abounds in them the most, though about Shubenacadie, Musquodobit, and Margaret's Bay, there are good finds.

Of the various stones used—quartzites, hardened slates, quartz, agate, jasper, amythest, trap, a yellow argillite, granite, sandstone, and soapstone, are found. I have seen only one specimen of sandstone, a pipe-bowl, found at Lunenburg, and one soapstone another pipe-bowl, found at Blomedon. I have never but in one instance, and that so imperfect that I could scarcely admit it, seen granite used. The hornstone pebbles, so common about the Bay of Fundy beaches, though to us well adapted for arrow-heads, seem never to have been used.

The stone instruments resolve themselves naturally into war and hunting implements—arrow-heads, spear-heads, and javelins; and into household ones—hammers, axes, gouges, chisels, hand wedges and knives. There are other implements found, very few in number, and whose uses we cannot apprehend. A stone shaped like an old fashioned gorget with a hole pierced through its flat axis, other egg-shaped stones, like sinkers. The very peculiar stone tubes of foreign stone found on the line of the Dartmouth canal, a very peculiar last shapen stone in the Mechanic's Museum, St. John, N. B.; other flat stones with holes pierced through them; and lastly, two circular stones, resembling a coiled snake, now in the Provincial Museum. These last are so peculiar, and bear so strongly on the universal snake worship papers lately put forward, as in the absence of all tradition or history of such worship in this province, to demand a paper to themselves.

The arrow-heads are barbed and straight, some with tangs, others without; some of beautiful work, others rough. The very characters of the old arrow makers are marked upon their work, and some so small that they must have been playthings. To us they seem all playthings, yet they were fixed to long shafts of great polish, and feathered with the tail feathers of the eagle. An eagle feather was worth a beaver skin, and LesCarbot saw at one wigwam five tame eagles with their tails cut off. The bow, probably of ash, was coarse but very strong, and the French were amazed to see among the dead brought home from the wars, a man and a dog transfixed by the same shaft. Those arrow-heads that I have seen, were chipped in making like those of all lands, except one which I own; that is polished like a celt, and is of hardened slate.

The spear-heads are the next numerous. They seem to have been both spears to carry in hand, and javelins to cast. They are also made by chipping, and are usually formed like the unbarbed arrow. A long oval with cutting edges and tang on the handle to fasten the shaft with. Many of these are so blunt and so broad, that one can scarcely distinguish them from knives. The knife has one convex and one straight edge, and is immediately known. A very fine one of hard red slate is in the museum of the St. John Institute.* They doubtless were fitted with wooden handles. Among the spear-heads are the beautiful ones found at Yarmouth, which have a centre line of elevation, and a beauty of shape and finish, and foreign air. With the exception of a large barbed arrow of amythest found on Digby Neck, they are the most beautiful found in the Province.

These finish the chipped stone. The next are hammers, axes, gouges, chisels, and what I term hand wedges, all ground and polished stones. The axes at once divide themselves into those with grooves around their centre, and the smooth ones. These weapons must have been used as wedges, and driven by mallets. They never cut a forest tree down with one. Indeed the stone men meddled little with great trees, and they used fire when they did. They made their stockades with living trees. For fire wood they collected windfalls. It was a folly to see the prisoners and women go leagues to collect dead wood, saith LesCarbot, when they were living in the forest. On the other hand, they are well adapted to splitting wood in all its forms,—to splitting bark from the birch trees, and to scraping the raw skins, breaking the grain and forming them into leather. When we find that the women did all these matters, built canoes, platted mats, and skinned the game, we are not surprised to find so many of them small, and running into hand axes, or wedges. Many of them have a groove for the left hand thumb to hold them by, when striking them with a mallet-head in right.

The corracle or boat built of wicker has ceased even in any tradition, but should not be lost sight of as an ethnological fact, connecting them with prehistoric men of the old world. I have attempted to restore handles to some of these axes, from our know-

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* Joe Glode, an admirable hunter and Indian, now dead, once shot a moose in the forest at Annapolis County, and having no knife, immediately took the flint out of his gun, bled and dressed the carcase with it. The Indians were a long time before they used percussion locks. The close cover and twigs of trees did not suit their careless handling. "See good many Indians no fore finger now, never saw them before *cussion guns*," was the sage remark of old Jack Glode.

ledge of those still in use. In cutting their skins and sowing them, they must have used bone implements, now lost. Some northern tribes fix the beaver's tooth into a wooden handle, and even carve stone with its hard enamel. Our Indian no doubt used that as well as bone hooks, and perhaps bone fishing spears. We find no stone fishing spears as are found towards the south, which makes me suppose they made them of bone. The small cannon bone of the moose is well adapted for this.

The chisels or wedges with long handles as well as the gouges, I think were used also in making arrow-heads. The hollow of the gouge preserving the fine edge. We now know these were made by bedding the stone firmly in wood, and making each chip by a smart blow. The gouge struck by a mallet seems well formed for this work. Some of these chisels may have been fixed in handles, and used as adzes. The pipe bowls speak for themselves. Their numbers are very few in comparison ; and we end with implements which either seem ornamental, as the gorget looking stones which have been suspended around the neck—or the long oval stones which may have been sinkers on fish lines. All these are very rare. The finely polished stone tubes found in one instance only at Dartmouth, have their fellows in the mounds of the Western U. States. We may only conjecture how they came there, as well as the stone coiled Snake, of which two only are known, and both in the Provincial Museum.

Of all these, the arrow heads are the most numerous, then the axes, hand axes and chisels, which are about as numerous as the spear and javelin heads,—gouges and unmistakable knives very rare, and the rest exceedingly rare.

The peculiar Serpent Stones in the Provincial Museum were found upon the surface, about sixty miles apart. The largest is three and one half inches on its long diameter, three on its short, with a very rude resemblance to a snake's head coiled above the tail. The other is about three inches in its long, and two and one half in its short diameter, and closely resembling the other. They are both of marble. There is no tradition of Snake worship, but they evidently appear charms.

Description of the Plate.

Nos. 1, 2, 3. Arrow heads, full size, barbed, unbarbed.
4. Knife blade, half size. } Restored to modern handles as the Indians now make them, substituting a piece of iron.
5. Axe, half size.
6. Unmistakable lance head, half size.
7. Pipe, upper part bowl, half inch.
8. Small wedge or hand axe, half size.
9. Serpent stone, half size.
10. Round plummet stone, half size, use unknown.

Art. V. On the Metamorphism of Rocks in Nova Scotia and Cape Breton. By Rev. D. Honeyman, D. C. L., F. G. S., &c.

(*Read Feb.* 10, 1873.)

All the pre-carboniferous rocks of Nova Scotia and Cape Breton are metamorphic; all in some degree have been subjected to regional metamorphism of greater or less intensity. Some in addition have been subjected to local metamorphism. From extensive observation I have been led to this conclusion. I find the Middle and Upper Silurian having metamorphic characters of a certain kind, which as a whole may be termed metamorphism of the third degree. I find the Lower Silurian having different characteristics, which dispose me to rank this metamorphism as of the second degree; and I find Cambrian or Laurentian as having other characteristics which give their metamorphism the first rank. I also find a local metamorphism of rocks in the third degree, which elevates them from the third degree to the second, leading to the inference that the virtual cause of this local metamorphism has, under certain conditions, effected all metamorphism, whether of the first, second, or third degree.

In my last paper I noted as the western boundary of the Lower Arisaig Series of crystalline rocks, the trap and conglomerate of Malignant Cove and Brook. Here the trap from north to south has a breadth of about half a mile, as shown by its outcrops in the brook, on the road, and in the adjoining fields. Isolated by this igneous rock is a patch of Lower Carboniferous conglomerate. This is divided in all directions by the trap which sometimes passes into it like veins. This arrangement is well seen below the mill dam. The consequence of this conjunction is that, conglomerate, generally loose in structure and yielding, is made intensely hard and resisting, forming a very rugged passage for the water below the mill dam, and a very great obstruction to the road maker. Here we have metamorphism of conglomerate by igneous action. Following the exposures of this trap westward we reach it where it comes in contact with the Upper Arisaig Series. This series is rendered metamorphic generally in the third degree, by what we call regional metamorphism. Here the trap forms a great dyke, dark and rugged; it is continued for about a mile, and for about half a mile it is interrupted, or passes under the sea; it reappears on the shore and continues until it nearly reaches the Frenchman's barn; it disappears and rises in the sea immediately north of the barn; it disappears, reappears to the east of Arisaig Pier, is interrupted, and then largely exposed, forming a great proportion of the break water of Arisaig Pier and Harbour.

This trap is generally homogeneous, sometimes porphyritic, frequently amygdaloidal, where decomposed vesicular. The crystals of the porphyritic are felspar,—the amygdala are calcite,—one cavity is filled with an agate. I found this in the trap at Doctor's Brook, some years ago, when dwelling among these rocks for the purpose of studying them. It thus appears that this trap is poor in minerals and very dissimilar to the traps of later age, *e.g.*, of Blomidon and Five Islands. On the north this trap is bounded by the sea; on the south of the trap we have the Arisaig Middle and Upper Silurian Series. Passing along the line of junction of the trap and overlying sedimentary rocks, which form the lowest part of the Upper Arisaig Series, or A. the possible equivalent of the Oneida conglomerate, we find on the east side of the Arisaig Pier, opposite the break of the trap already noticed, low banks of the third degree; they are in marked contrast with the other parts of the same band, and the overlying strata. Higher in the series we have the slates, having cleavage and other characteristics of the degree of metamorphism indicated. To the east of the arenaceous shales is an eminence—red, prominent, and visible at a great distance, forming a land mark. At the north of this, and in contrast with it, is porphyritic and amygdaloidal trap, which have parcellanized the arenaceous strata, but only in such a degree as to render them readily fissile.

On the north-west, the same strata, forming part of the pier, are in contact with the massive trap already referred to, and have consequently been hardened in an extreme measure. The massive rock is jaspideous and uncleavable, being generally uniform, sometimes beautifully banded, and reticulated with veins of quartz and sulphate of baryta. The boulders of this rock rolling on the shore, when washed by the sea, are beautiful and varied; they are as hard as quartz, and susceptible of a high polish. The Frenchman's barn is another part of the same band. I have observed that the trap lies in the sea on the north of this rock. The north side of the rock is a wall washed by the sea. This is an enormous mass of jaspideous rock metamorphosed by the action of the trap. It is also pervaded by quartz and sulphate of baryta veins.

At Black Rock where the trap from the east first meets with the Upper Arisaig strata, we have also the same lower band metamorphosed and converted into a very hard brown jaspideous rock. When broken this shows in cells, iron and copper pyrites, and malachite. Connected with this I discovered in 1869 a soft rock easily cut with a knife, and having a greasy touch. This rock is of brown and variegated colour, and is susceptible of a fine polish. When I found it, I believed it to be saponite, var. rensselaerite. It is now believed to be a silicate of alumina, somewhat resembling agalmatolite. The rock appears to be about twelve feet wide; it has the hard jaspideous rock below and above. The stratum appears to be lenticular. Its next appearance is a little to the east of the Frenchman's barn: here it comes out of the sea. Its colours are yellow, orange, and red; specimens are very beautiful when polished. It passes on the south side of the Frenchman's barn, where it appears as a shaly rock, having singularly granular nodules, which give it the appearance of conglomerate. Farther west from the barn, the rock under notice has its maximum thickness. Here it consists of mahogany coloured states, having the general characteristics, viz: softness and greasiness; it is also susceptible of polish, but it soon tarnishes on account of the presence of abundance of minute crystals of sulphuret of iron? It has slaty cleavage. There is also a considerable thickness of rock, which is more compact. This has been quarried to some extent, with the expectation of obtaining a solid and ornamental stone. In this are transparent veins which have all the appearance of true *agalmatolite*. Its next occurrence is at Arisaig Pier, where the finest variety is found. This takes a fine polish and retains it. The only other noticeable rock of the band is on the south of the Frenchman's barn. It has all the appearance of a serpentine, but it is a green and brown jaspideous rock.

Overlying this band of metamorphic rocks, is, first of all, fossiliferous strata of Mayhill Sandstone age—according to Mr. Salter. I regard them as the probable equivalent of the Medina Sandstone of the United States: these are partly arenaceous, sandy, and in the usual condition of strata of this horizon holding fossils; the only peculiarity is that in the lower parts there is abundance of cubical crystals of iron pyrites. The only obvious consequence of Trappean interference is the tilting of the shale. The Lower Clinton shales overlie; there argillaceous strata have also been disturbed but not hardened, and this is also the case with the other overlying formations. All show the effects of regional metamorphism, but local metamorphism is confined, to all appearance, to the lowest strata which I have described. By volcanic heat and the presence of the trap which communicated it, aided by the moisture necessarily contained in the strata, rocks have been produced, and minerals which correspond very closely with the crystalline rocks of George's River, Cape Breton. In both there are jaspideous rocks and a mineral not distinguishable from agalmalotite; the other hydrosilicate of alumina *strata*, show metamorphism equally or nearly so with the hydrosilicates of magnesia, *serpentines;* and the want of marble may be in consequence of the absence of fossiliferous limestone in the original limestone strata.

In the case of the metamorphic strata of Cape Breton, the metamorphism is regional, as at Arisaig, this metamorphism being prior to the eruption which produced the trap there observed. This metamorphism was the effect of hydrothermal action under pressure — the heat being derived from the source of internal heat,— the pressure being that of superincumbent strata, or of the waters of the ocean. This is the origin of the general metamorphism which I referred to at the outset, to which all the precarboniferous rocks of Nova Scotia and Cape Breton have been more or less subjected.

I have thus illustrated the subject of my paper, but I have still some observations to make in connection with the trap which has occupied so much of our attention. Passing from the Arisaig Pier in a south-west direction, we reach the junction of the Upper Arisaig Series, with the Lower Carboniferous — to the east of McAra's Brook. All the interval is covered by the sea, and consequently any underlying exposure of trap is obscured. At the junction is the base, and a small part of a great mass of amygdaloid trap, which a few years ago formed a prominent and picturesque feature. This was then overlying and obscuring the point of junction which is now exposed. The prominent effect of this intrusion is the change of the general direction of the dip of the Upper Silurian strata, and elevation of the overlying and unconformable Lower Carboniferous conglomerate. There is a distinct slaty cleavage in the disturbed Silurian strata which is at right angles to the plane of stratification. (*Vide* specimen with fossil.) Onward we find it occurring at the mouth of McAra's Brook, and then at intervals in connection with the Lower Carboniferous strata, appearing as if interbedded. At McAra's Brook, at the junction of the Silurian and Lower Carboniferous grits, there is another outcrop of the same trap. We shall leave it here, and return to the trap at Malignant Cove and Brook.

We have followed the course of the trap dykes on the north of the Upper Arisaig Series. We find another series of outcrops passing along on the south. This first meets the Silurian strata— south from the mouth of Doctor's Brook where the East Branch turns to the south. This brings up the strata of Upper Clinton age with its characteristic fossils; these have a northerly dip. It passes an insulated patch of Lower Carboniferous strata, consisting of conglomerate and limestone dipping in the same direction with the Silurian strata; outcropping on the southern bend of West Branch of Doctor's Brook in several places, bringing up in its course the same strata, with the addition of overlying Upper Silurian strata, giving them all a northerly dip. It outcrops on the elevated ground where the track turns to the north; this is nearly south of Arisaig Pier. From this onward its course is obscured. Its influence is manifest from the continuation of the elevated ground —south of the ravine in which Arisaig Brook flows, which is evidently the effect of the elevation of the Silurian obscured strata. When we reach the end of the ravine from which a branch of Mill Brook now flows, the trap is seen to outcrop to the south of MacAra's Brook, the eastern extremity of the Upper Arisaig Series. This series is thus bounded on all sides by trap.

Returning to Malignant Brook, we find the trap of the Sugar Loaf Series, the red metamorphosed strata of the Upper Silurian of the Mountain Series on the south. This is the southern part of a band which is found undivided, south of the Upper Arisaig Series, but is divided into three parts by the trap, on the east side of the mountain part of the East Branch of Doctor's Brook. On the west side of this part of the tract this trap is largely exposed; here it is associated with a dark brown porphyritic rock which underlies the Lower Carboniferous patch already referred to. It then runs to the south of the red band, being often exposed in its course, and then appears to terminate in a fine exposure on the side of the West Branch of Doctor's Brook, south of Arisaig Pier.

The lower part of this mountain series or Middle Silurian metamorphic, is bounded by and underlaid by the syenite of McNeal's mountain, which rises to 1010 feet above the sea level. The diorite of Mackintosh's on the top of East Branch Doctor's Brook, and the syenites which lie in the rear of McDonald's mountain, south of the Frenchman's barn, and in the table land south of Arisaig Pier.

You will have observed that the trap besides being the agent in local metamorphism, has also been a great intruder and disturber of the Upper Silurian and Lower Carboniferous rocks of this locality. These have been tilted and altered and elevated by its force in a manner singular and perplexing. The two insulated patches of

Carboniferous strata, the position of the red stratum, and the isolation of the Upper Arisaig fossiliferous strata, attest this. Yet I believe that it has been a benefactor to our geology, as I consider that without it this interesting and typical series which is of so much service in the illustration of Nova Scotian Geology, would still have been hidden in the depths.

Art. VI. On the Vegetation of the Bermudas. By J. Matthew Jones, F. L. S.

The Bermudas, sometimes known under the almost obsolete name of The Somers' Isles, are situate in 32° 15′ north latitude, and 64° 51′ west longitude, being distant from the nearest land, Cape Hatteras in North Carolina, about 600 nautical miles.

The general features of the group present no remarkable attractions; merely an elongated strip of land about 25 miles in length, somewhat in shape like the letter J without its horizontal summit, slightly elevated above the surrounding ocean, and broken more or less into a series of disconnected patches, which, although in reality islets, are only slightly separated from the principal body of land which may be called "Bermuda proper." On its northern side, this strip of land as seen from sea, presents a rugged coast outline, composed alternately of cliffs of slight elevation and lowlands faced seaward with a strip of shelving sand beach, or masses of wave worn rock channelled and fretted by the ceaseless action of the waves. The whole is surrounded by a barrier reef formed of the same calcareous limestone as the islands, coated with serpulæ; which, although originally the coast line of the Bermuda land is now wholly submerged at high water, save at one point to the north, where on the line of this barrier reef stand four pinnacles of rock about ten feet above high water.

The surface of the land, which is nowhere higher than 250 feet, appears on trivial inspection to be composed of sand and soil interspersed with rock, and clothed over its whole extent with stunted cedars. In certain places where the land lies nearly on a level with the sea and is not far removed from it, occur tracts of marsh which having communication with the ocean through the intervening rock, are more or less overgrown with reeds and sedges, from out which in the drier spots the palmetto raises its plume-like foliage. Not a brook or natural watercourse of any kind can be observed anywhere, nor will even the strictest search reveal a spring of fresh water of any kind, the only supply of that element coming from the clouds.

The geological character of the islands is extremely interesting, as their isolated position and irregular formation have always been considered to partake of the mysterious. Although the superficial aspect of the Bermudas at once proclaims wind-power as the chief agent in forming the more elevated parts of the land, through the medium of drift sand, we have every reason to believe from recent observations that the Bermudas rest upon a basis of compact limestone. The higher grounds are coated with a layer of sandy earth, the sand generally predominating as we proceed upwards, finally becoming almost fine sand and of course unfavorable to the growth of plants. This feature, however, is not universal, for in some parts of the islands we meet with depressions on the higher lands, in which is found a shallow coating of light coloured red earth, more or less mingled with sand and vegetable mould. This red earth of the hills is different, however, both in colour and composition to that which is found along the shore line, and especially the district of Walsingham; this latter earth which is of a chocolate colour, partaking more of the nature of clay, and possessing a greater proportion of oxide of iron and alumina. It was in 1859 that our attention was first attracted to the large amount of oxide of iron and alumina contained in this dark coloured "red earth," for having on our first visit to the islands obtained a sample, we submitted it to Dr. Albert Bernays, Analytical Chemist of St. Thomas Hospital, who very kindly analyzed it and gave as the result 35.50 of oxide of iron and alumina. Later still, through the kindness of Major General Lefroy, C. B., F. R. S., the present Governor of Bermuda, we have been favoured with the analysis of Messrs. Abel and Manning, which gives for four samples from different localities the following results:

ABEL.

	Alumina	11.74.
	Sesqui-Ox. of Iron	7.63.

MANNING.

No. 1.	Alumina	13.604.
	Sesqui-Ox. of Iron	12.310.
No. 2.	Alumina	7.368.
	Sesqui-Ox. of Iron	9.964.
No. 3.	Alumina	22.790.
	Sesqui-Ox. of Iron	28.318.

Now the presence of nearly 30 per cent. of oxide of iron in the soil of an island so small and remote from any continent naturally perplexed us, as no clue could be gained as to its probable origin; nor was it until the recent deep sea explorations of the "Challenger," that light was thrown upon the question. In "Nature" (vol. 8 p. 30) we find that on approaching the West Indian Islands, more particularly in the deeper soundings, a peculiar "red clay" gradually assuming a darker tint until it becomes chocolate in colour, was met with; and that this red clay was found the greater part of the distance from St. Thomas to the Bermudas; and moreover, it is stated that this red clay of the deep sea proved on analysis by Mr. Buchanan, chemist to the expedition, to be "almost pure clay, silicate of alumina, and the sesqui-oxide of iron with a small quantity of manganese." This analysis tends to convince us that the deep chocolate coloured red clay of the islands found in the lower levels, and from high water mark some distance into the sea, originally came from the ocean floor, and that when by volcanic agency the Bermuda column was raised from the depths of the sea, its summit, most probably broken in outline, appeared above the surface covered with this red mud, which in the course of ages has but slightly changed its composition. and yet possesses sufficient evidence to prove its identity with that now lying contiguous to the base of the Bermuda column. Further remarks, however, on this subject are unnecessary in a botanical paper, which is only intended to describe the geological character of the islands as connected with their vegetation.

The large deposits of peaty mud of the marshes is also worthy of note, as it may afford some idea of the time requisite to fill up with such vegetable matter the deep cavities they originally presented. Although always proclaimed to be very deep, yet no satisfactory information on the subject could be obtained until the past year, 1872, when soundings were made by His Excellency the Governor, in the Pembroke Marsh below Government House, by means of a series of lengths of iron gas piping about 1 in. diam. screwed into each other, the lower length having attached to its foot a well-contrived auger, which, being wrenched around from above, filled a chamber with the material it came in contact with at the bottom. The deepest sounding gave 46 feet of this peaty mud, and the auger borings afforded evidence of the mud reaching quite to the limestone floor of the marsh basin, portions of the limestone filling the lower part of the chamber and peaty mud the upper.

The Bermudian climate partakes of a temperate and tropical character, for during seven months of the year, November to May inclusive, the thermometer rarely rises above 75°, the minimum being reached in the months of February and March, but seldom lower than 50°. During this period, which may be called the "cool season," the weather is very variable, alternate storm and calm, a circumstance rendered too notorious by the large number of vessels which in a shattered or sinking condition are constantly arriving. The other portion of the year from June to October inclusive, which may be termed the "hot season," is peculiarly warm, day and night almost alike in temperature from the radiation of heat from a white sandy ground surface, almost wholly exposed to the glare of a sun which is constant—a cloudy sky being a somewhat remarkable event during the Bermudian summer. The sand formation charged with this great heat during the hours of the day, only loses a few degrees of heat during the night, so that the heat is almost continuous, when it positively sets in, which is about the middle of July. From this date, often until the end of September, a frequent calm prevails, day succeeds day of perfect stillness; no trade wind lends its refreshing influence in mitigation of the heat, and long continued droughts are prevalent, which combined with the scorching rays of the blazing sun, blast all vegetable growth, and render the more elevated districts arid and waste. The climate of the Bermudas is, therefore, not favourable to the growth of plants during summer as a rule, and it is only in the cool season that any luxuriance of flower or foliage can be observed.

The origin of plant life upon the Bermudas, is a question not very difficult of solution, after a careful consideration of facts accruing from the continued observations of several years. The islands are greatly influenced by the current of the Gulf Stream, which brings to their shores numberless objects, animate and inanimate, from the Caribbean Sea. Among such we may instance the seeds of trees, shrubs and plants, which are continually being cast ashore; while the occurrence of several forms, even forest trees, just above high water mark, go far to prove their drift origin. The hard seeds of the Leguminosæ seem especially adapted to withstand immersion in salt water for a length of time, and the fact of this order being better represented than any other favours the presumption. But although several leguminous seeds germinate on the Bermudas, there are some commonly cast ashore which do not; such are the seeds of *Entada scandens*, and *Mucuna urens*, which have never yet grown on the islands, notwithstanding their seeds are frequently landed near the trailing stems of *Canavalia obtusifolia*. Probably the sandy soil of the beach is unsuited to these species, which appear to grow on river banks in the West Indian Islands.

Many of the European weeds have doubtless been introduced at the first settlement of the islands, when several consignments of field and garden seeds were, according to old records, forwarded by the original "Bermuda Company" of London. Seeds in those days were probably often carelessly gathered, and often mixed with those of the weeds growing with them. As to the origin of the cedar tree, which appears from time immemorial to have been the principal feature of the Bermudas, it is somewhat perplexing. Griesbach has carefully determined it as *Juniperus barbadensis*, which is a true West Indian form; whereas it has always hitherto been taken for a variety of *J. virginiana*, which is found throughout eastern North America. Had it been the latter species we should at once have instanced the cedar waxwing (*Bombycilla* *carolinensis*,) as the agent, for these birds visit the islands nearly every winter in small flocks, often being blown off the American coast. A flock of these birds with crops well charged with cedar berries, leaving the American coast before a westerly gale, could land on the islands in twenty hours, if not less, and the seeds would have lost none of their vitality. With the West Indian form it is different. Few migratory birds visit the Bermudas from the West Indies, on their return north in spring, keeping to the continent in their progress; so we can only look to the Gulf Stream current as a means of transportation in the case of this species. Many of the trees, shrubs, and plants of North America must certainly have been introduced by birds, a large number of species, natives of that continent, annually visiting the islands. The waders and water birds could easily retain small seeds in the mud adhering to the soles of their feet, which would not be released until at the end of their lengthy but soon accomplished flight, they alighted on the shores or in the marshes of the Bermudas. Probably all the fruit-bearing trees have been introduced by the inhabitants, as have also the palms, with the exception of the palmetto.

Many additions have been made to the flora during the last two years through the assiduity of His Excellency the Governor, who from his first arrival in the colony has paid particular attention to the growth of new trees, shrubs, and plants. During the past year His Excellency has sown and distributed throughout the islands packets of seeds from Kew, representing no less than 600 species, principally of trees and shrubs suited to sandy coast soils, which we sincerely trust may grow and thrive, so that in future years the inhabitants may enjoy the benefit of a more suitable arborescent vegetation, and remember with gratitude the name of their benefactor.

In the foregoing brief sketch of the physical aspect of the Bermudas, we have endeavoured to exhibit the more interesting particulars, in order that the readers of this paper may possess a fair idea of this oceanic land which is rarely visited by naturalists; while in conclusion we cannot fail to mention the kind assistance we have received from His Excellency the Governor, who in the most liberal manner placed a long list of the plants of the islands identified by himself and Dr. Hooker, at our disposal, and in various other ways has, during our two last visits to the islands, furthered our object of making this addition to our previous publications on the natural history of the group.

RANUNCULACEÆ.

Clematis japonica, *D. C.* Hab. Japan.

Ranunculus muricatus, *L.* Hab. Europe.

R. parviflorus, *L.* Hab. Europe.

Delphinium —— ?

MAGNOLIACEÆ.

Magnolia grandiflora, *L.* Hab. Southern States of America. A fine specimen grows at Mrs. F. Peniston's in Smith's parish, which did not blossom for twenty years after it was planted.

Liriodendron tulipifera, *L.* "Tulip Tree" of North America, where in favorable situations it attains a large size. The few trees which exist at the present time in the Bermudas, are of small size in comparison with those of the American continent.

ANONACEÆ.

Anona reticulata, *L.* "Custard Apple" of the West Indies. It grows well in the Bermudas, especially in Mr. Perot's garden at Hamilton.

A. muricata, *L.* "Sour-sop." Hab. West Indies. A tree at "The Hermitage," supposed to have been planted about sixty years ago, was never known to bear fruit until 1870, when three fruit only ripened.

A. cherimolia, *Mill.* "Chermoi Apple," or "Cherimoya." This tree which is a native of the western part of Central America, is rare in the Bermudas, although it grows well from seed, and the fruit sometimes attains a weight of 2 lbs.

Rollinia sieberi, *D. C.* Hab. West Indies. (Anona reticulata, *Sieb.*)

SARRACENIACEÆ.

Sarracenia purpurea, *L.* Hab. N. America. Mount Langton garden.

PAPAVERACEÆ.

Argemone mexicana, *L.* "Lady Thistle." Very common in gardens and waste ground which has been cultivated. From its flowers is sometimes made a yellow dye, with which the islanders colour ribbons and other small articles. It flowers about the end of March or beginning of April. The plant appears to have a very wide geographical range, being found in the northern as well as southern States of America, West Indies, India, China, and probably all over the tropical as well as temperate regions of the globe.

Papaver —— ? Varieties cultivated.

FUMARIACEÆ.

Fumaria officinalis, *L.* Hab. Europe.

CRUCIFERÆ.

Lepidium virginicum, *L.* "Pepper Grass." A common weed in waste ground.

Iberis violacea, *D. C.*

Cochlearia officinalis, *L.* "Scurvy Grass." Common every where along the shore, sometimes attaining a large size, almost a bush, in sheltered places beneath the cliffs of the south shore at Devonshire Bay. In flower March and April. It is used as a cure for diarrhœ, and also for cleansing the blood.

C. armoracea. "Horse Radish." Cultivated.

Nasturtium —— ? Varieties cultivated.

Cheiranthus —— ? "Wall Flower." Varieties cultivated.

Matthiola —— ? "Stock." Wild among the rocks below Gibb's Hill light house, south shore of Port Royal. Varieties also cultivated in gardens.

Brassica —— ? "Cabbage." Varieties cultivated.

Beta —— ? "Beet." Varieties cultivated.

Sinapis —— ? "Mustard." A very troublesome weed growing in cultivated ground. I think there are two species.

Rhaphanus —— ? "Radish." Varieties cultivated.

Malcomia maritima, *D. C.* Hab. S. Europe.

CAPPARIDACEÆ.

Steriphoma elliptica, *Spreng.* Hab. S. America.

RESEDACEÆ.

Reseda odorata, *Spreng.* "Mignonette." Cultivated. Hab. Egypt.

FLACOURTIACEÆ.

Flacourtia prunifolia.

HYPERICACEÆ.

Hypericum —— ? Pembroke Marshes.
Vismia guianensis, *D. C.* Hab. Guiana.

CARYOPHYLLACEÆ.

Dianthus —— ? "Pink." "Carnation." Varieties cultivated.
Saponaria calabrica, *Guss.* "Soapwort." Hab. Calabria.

PORTULACEÆ.

Portulaca oleracea, *L.* "Purslane" "Pursley." Hab. All tropical as well as temperate regions. A common weed, generally found in cultivated ground. In flower end of March and beginning of April. It is sometimes used as a vegetable, boiled, and seasoned with pepper and salt. Pigs and poultry are fond of it.

FICOIDEÆ.

Sesuvium portulacastrum, *L.* "Sea Purslane." In sandy mud above high water mark. This plant is found on all temperate as well as tropical shores throughout the globe.
Mesembryanthemum glaciale, *Haw.* "Ice Plant." Cultivated. Hab. Greece.

MALVACEÆ.

Malva —— ?
Modiola caroliniana, *G. Don.* (M. multifida, *Mœnch*—Malva caroliniana, *L.*) Hab. N. America.

Sida carpinifolia, *L.* (S. acuta, *Burm.*—S. stipulata, *Cav.*—S. glabra, *Nutt.*—S. Berteriana, *Balb.*—S. balbisiana, *D. C.*—S. brachypetala, *D. C.*—S. trivialis, *Macf.*—S. lanceolata, *Rich. Cub.*—S. obtusa, *Rich.*) "Wire-weed." One of the most common plants of the islands, overrunning roads and pastures. It is in flower nearly all the year round, and in rich ground grows into a perfect shrub, some three feet high. The flowers are sometimes used to make a healing ointment, being boiled in lard, which is then strained and allowed to cool. Horses are fond of this plant. In the West Indies the Sidas are known under the name of "broom-weed" from their tough and flexible nature.

Abutilon striatum, *Dicks.* Hab. Brazil.

Hibiscus rosa-sinensis, *L.* Hab. East Indies.

H. grandiflorus, *Michx.* Hab. Florida, Georgia.

H. mutabilis, *L.* "Changeable Rose." Hab. East Indies.

Gossipium herbaceum, *D. C.* Hab. East Indies.

Paritium tiliaceum, *A. Juss.* Hab. All tropical sea shores.

Thespesia populnea, *Corr.* Hab. All tropical shores.

Althæa officinalis, *L.* "Marsh Mallow." Hab. Europe.

A. rosea, *L.* "Hollyhock." Varieties cultivated. Hab. China.

BOMBACEÆ.

Eriodendron anfractuosum, *D. C.* (Bombax ceiba, *Lun.*—B. pentandrum, *Cav.*) "Silk Cotton Tree." Hab. West Indies and equatorial America.

TILIACEÆ.

Triumfetta semitriloba, *L.* (T. heterophylla, *Lamx.*—T. havanensis, *Kth.*—T. ovata, *D. C.*—T. ulmifolia, *Desv.*—T. diversiloba, *Prl.*—T. angulata, *Wall.*—T. rhomboidea, *Griseb.*) "Wild Hemp" of Barbados, and "Bur-bark" of Jamaica. All tropical countries.

T. althæoides, *Lam.* Hab, West Indies and tropical South America.

Berrya ammonilla, *Roxb.* Hab. Ceylon.

GUTTIFERÆ.

MAMMEA AMERICANA, *L.* "Mammee Tree." "Mammee Apple." Hab. West Indies and equatorial America.

CALOPHYLLUM CALABA, *Jacq.* "Galba." Hab. West Indies and equatorial America. Fine examples of this tree grow on the road side at Mr. T. Fowle Tucker's, Devonshire Parish. They were brought from the West Indies. The fruit is considered poisonous by the inhabitants.

MALPIGHIACEÆ.

MALPIGHIA URENS, *L.* (M. martinicensis, *Jacq.*) "Cowhage Cherry" of Jamaica. "Stinging Cherry" of Barbados. Hab. West Indies.

SAPINDACEÆ.

BLIGHIA SAPIDA, *Koen.* (Akeesia africana, *Tuss.*) Hab. Western Africa.

SAPINDUS SAPONARIA, *L.* "Soap-berry Tree." "Black Nicker Tree" of Barbados. Hab. Tropical America and West Indies. The first tree known in the Bermudas, originated from drift seed. It may be considered rare, as few examples are to be found on the islands. Flowers in January. In 1841 a plant sprang up from a heap of seaweed, collected during the previous antumn for manure.

NEPHELIUM LITCHI, *Don.* (Dimocarpus Litchi, *Willd.*—Scytalia chinensis, *G.*—Euphoria Litchi, *D. C.*)

DODONÆA VISCOSA, *L.* (D. Candolleana, *Bl.*—D. arabica, *Hochst.*)

D. ANGUSTIFOLIA, *Sw.* (D. bialata, *Kth.*—D. linearis, *E. Mey.*—D. Mundtiana, *Eckl.*—D. Schiedeana, *Schlecht.*)

ÆSCULUS HIPPOCASTANUM, *L.* "Horse-chestnut." Hab. Asia.

MELIACEÆ.

MELIA AZEDARACH, *L.* "Pride of India." "Lilac" of Barbados. "China Tree" of the Southern States of America. Hab. Asia. This is one of the few trees that loses its foliage in the winter season. It usually flowers about the end of March, the flowers appearing before the leaves. In winter it has a curious appearance, having the seed berries hanging in bunches from the ends of the twigs denuded of leaves. The wood is brittle, and high winds play sad havoc with the lengthy branches. Its light and feathery foliage recommends it as one of the best of shade trees, but strange to say although hundreds of young trees shoot up every spring from the fallen seed of the previous winter, the idea of transplanting them about the woodlands to relieve the monotonous appearance of the interminable red cedar, is never entertained by the inhabitants.

CEDRELACEÆ.

SWIETENIA MAHAGONI, *L.* "Mahogany Tree." "Caoba" of the Spaniards. Hab. West Indies and Central America. The Bermuda trees are stunted in growth compared with those of the tropics. The oldest known tree in the islands is at the entrance gate to the house of the late Mr. Samuel Musson, at the Flatts.

CHLOROXYLON SWIETENIA, *D. C.* (Swietenia chloroxylon, *Roxb.*) "Satin-wood." Hab. East Indies.

AURANTIACEÆ.

CITRUS AURANTIUM, *L.* "Sweet Orange." Hab. Asia. The climate of the Bermudas appears to suit the Citri well, for the trees are remarkable for vigorous growth and the flavour of the several kinds of fruit is excellent. Of the sweet orange some three or four varieties are cultivated, but to so small an extent that the supply is nothing like equal to the demand. In the year 1854–5 the orange trees became diseased from the attack of a species of *Coccus*, and hardly an orchard escaped save those of the parish of Somerset at the western end of the islands. In many cases not a tree survived the ravages of these insects, and in one instance an orchard of fine young trees 300 in number about twelve years old was entirely destroyed. The fruit sometimes attains a large size, and one of a dish of oranges which took the first prize at the Bermuda Exhibition of January 1872, measured 13¾ inches in circumference, and nine of these oranges weighed 10½ lbs. These large oranges, however, are generally coarse inwardly and are by no means to be compared with many of smaller size for amount of juice and flavour. The medium sized orange with thin smooth skin is always to be preferred before the larger kind having a coarse-grained skin. The orange has been known in the Bermudas from their first settlement, for the original Bermuda Company sent out seeds from England in 1615. Seeds have also been brought at various times from Madeira, Lisbon, and other places. The orange season generally begins about the end of November and continues until the end of February. It may not be generally known that the common sweet orange will stand severe cold. Mr. W. M. Redhead (Lin. Soc. Journ. Bot. Vol. IX.) states that it grows in the open air at the Convent of St. Catherine, Sinai, where during the winter the frost is severe enough to freeze water within the cells of the convent.

C. AURANTIUM, *var.* BIGARADIA, *Duh.* "Sour Orange." "Seville Orange." It is from this variety which is frequently found growing in a wild state, that marmalade is made, but owing to the want of the requisite knowledge in regard to the proper method of manufacture the preparation made on the islands is not of a superior description. The trees yield abundantly where sufficient space is allowed for sun and air to get to them. When perfectly ripe the fruit turns to a dark orange colour.

C. NOBILIS, *Lour.* "Mandarin Orange." Hab. China. This species which is by no means common, possesses a peculiar flavour, if anything, richer than that of the common orange. The fruit is smaller in size, and of a deep orange colour when ripe.

C. NOBILIS, *var.* MINOR. "Tangierine Orange." Not common.

C. DECUMANA, *L.* "Shaddock." "Pimple Nose Tree" of Barbados. Hab. Asia. Grows well and produces fine fruit.

C. RACEMOSUS, *Ris* et *Poit.* "Grape Fruit." Hab. Asia, common.

C. BUXIFOLIA, *Poir.* (C. Paradisi, *Macf.*) "Forbidden Fruit.' Hab. Asia. Rare.

C. LIMETTA, *Riss.* "Lime." Hab. Asia. Grows wild all over the islands. Also cultivated.

C. LIMONUM, *Riss.* "Lemon." Hab. Asia. Two or three varieties. The common lemon grows wild every where, but not in such abundance as before the disease of 1854–5, which attacked the lemon as well as the orange. Thousands of fine trees before that date existed throughout the cedar groves, and the fruit was so abundant that it only ripened to fall and rot upon the ground. A variety known as the "Lisbon Lemon," is cultivated and more highly esteemed than others.

C. MEDICA, *L.* "Citron." Hab. Asia.

COOKIA PUNCTATA, *Retz.* "Wampee Tree."

LIMONIA CRENULATA, *D. C.*

MURRYA EXOTICA, *L.*

GERANIACEÆ.

GERANIUM PUSILLUM, *L.* Hab. Europe; N. America.

G. —— ? Varieties cultivated.

PELARGONIUM —— ? Hab. S. Africa.

BALSAMINACEÆ.

IMPATIENS HORTENSIS.

OXALIDACEÆ.

OXALIS CORNICULATA, *L.* (O. stricta, *Sw.*) Hab. Europe; N. America. Rich moist ground. Not common: Flowers end of March.

ZYGOPHYLLACEÆ.

GUAJACUM OFFICINALE, *L.* "Arbor-vitæ." "Guayacan" of the Spanish West Indies. Hab. W. Indies and Central America.

MELIANTHUS MAJOR, *D. C.* Hab. C. G. H.

SIMARUBACEÆ.

QUASSIA AMARA, *L.* "Gall Tree" of Barbados.

ANACARDIACEÆ.

RHUS TOXICODENDRON, *L.* "Poison Vine." "Poison Oak." Hab. N. America. Common in thickets, mouths of caverns, &c., especially on some of the islands of the Great Sound. It is strange that this plant should prove so poisonous to some persons that even a close approach to it is sufficient to cause a severe attack of inflammation of the face, while others may handle it, or even rub the leaves on their faces with impunity. R. radicans is merely the climbing variety of this species.

MANGIFERA INDICA, *L.* "Mango." Hab. East Indies. A fine specimen some forty or fifty feet high, and nearly seven feet in circumference at base, grows in Mr. Robert Lightbourne's garden in Warwick parish. Fruit weighing 13 ozs. each have been taken from this tree.

ANACARDIUM OCCIDENTALE, *L.* "Cashew-nut." Hab. W. Indies and tropical America.

VITACEÆ.

VITIS VINIFERA, *L.* "Grape Vine." Hab. Asia. The cultivation of the grape in the Bermudas dates back as far as the year 1615, when the original Bermuda Company sent out cuttings with the following instructions to Governor Tucker: "Wee have sent you vynes and vyne cuttinges to be put in the grounds. Lett them be fenced from cattle and conies, and kept cleare from weeds, and multiplye them by puttinge all yor vyne cuttinges everye yeare into the ground, that you may have many acres in severale places planted with them 8 or 10 foots asunder. You may leade them alonge or upright upon poles, or lett them runne from tree to tree, at pleasure."

Whether the early settlers carried out these instructions, and formed vineyards, history does not relate, but it is very clear that in the year 1764 the cultivation of the grape was not viewed with much interest, for we find that in that year one Chauvet who merely petitioned the Governor in Council to allow him a small grant in aid of grape culture, was ordered to attend the bar of the House for his presumption.

That the grape vine grows freely and produces abundantly in the soil and climate of Bermuda, when planted in a favourable situation and well manured and watered, is well known; but as the only fresh water supply comes from the clouds, and the soil is often subject to severe droughts, cultivation on an extensive scale would not succeed.

RUTACEÆ.

RUTA GRAVEOLENS, *D. C.* Hab. S. Europe.
AILANTHUS GLANDULOSUS, *D. C.*

XANTHOXYLACEÆ.

XANTHOXYLUM ——— ?

LEGUMINOSÆ.

MEDICAGO LUPULINA, *L.* "Clover." This little plant is very common throughout the islands, more especially on pasture lands. It forms a very nutritious fodder where herbage is scarce, as it always is on the porous calcareous soil of these islands. It thrives in the shallowest soil, and its small yellow flower may be seen even on the rocky slopes where the merest scrap of earth affords the plant a rooting place. Horses and cows are very fond of it, clipping it as close as their teeth will allow. It was one of the few plants mentioned by Michaux on his visit to the Bermudas in 1806.

MELILOTUS OFFICINALIS, *Willd.* "Melilot." This plant grows freely in different parts of the islands, especially in the valleys where a good depth of rich soil prevails. Strange to say, in a country like Bermuda where forage is so scarce and expensive, no effort has been hitherto made to lay down pasture land on which to grow this and the foregoing plant mixed with grasses. I have observed it growing in favourable situations at least three feet in height, where the common grass of the islands was only of diminutive size.

SPARTIUM JUNCEUM, *D.C.* "Broom." Hab. S. Europe. This shrub has been lately introduced by Governor Lefroy, and is growing well. Apart from the pretty appearance its bright yellow blossoms will present amid the sombre foliage of the all-prevailing cedar scrub, its peculiar property of binding together drifting sand, will render it of great value on the southern shores of the islands.

ROBINIA PSEUDACACIA, *L.* "White Acacia." Hab. N. America.
R. DUBIA.
WISTARIA FRUTESCENS, *D. C.* Hab. S. States.
ULEX EUROPÆUS, *L. var.* stricta. "Furze," or "Gorse." The

author claims to have first introduced this familiar English shrub into the Bermudas, having raised healthy young plants from seed taken from Southampton Common. It will form another useful forage plant, as when cut up and bruised in a mill it is much relished by cattle, and is very nutritious. According to Grisebach it grows in the higher mountains of Jamaica, where it has been introduced.

INDIGOFERA TINCTORUM, *L.* Hab. E. Indies.

VICIA SATIVA, *L.* Common in pasture land. This plant is widely distributed over the globe, being found in the temperate and tropical regions of both hemispheres.

LATHYRUS ODORATUS, *D. C.* "Sweet Pea." Hab. Sicily.

PISUM SATIVUM, *L.* "Pea." Hab. S. Europe. Varieties cultivated.

PHASEOLUS ——? "Kidney Bean." Varieties cultivated.

ERYTHRINA CORALLODENDRON, *L.* (E. speciosa, *Andr.*) Hab. W. Indies and central America.

E. INDICA, *Lam.* Hab. Tropics of both hemispheres.

MYROSPERMUM TOLUIFERUM. Hab. S. America.

M. PERUIFERUM.

CAJANUS INDICUS. *Spreng.* (Cytisus Cajan, *L.*—C. flavus, *D.C.*) "Pigeon Pea." Hab. Tropics of both hemispheres. Common on David's Island.

CLITORIA TERNATEA, *D. C.* Hab. East Indies.

CYTISUS LABURNUM, *D. C.* "Laburnum." Hab. Europe.

CANAVALIA OBTUSIFOLIA, *D. C.* (Dolichos rosens, *Sw.*—Canavalia rosea, *D. C.* "Bay Bean." Hab. Tropics of both hemispheres, on sandy sea shores among stones. Very common on the southern shore of the Main island, trailing over the rocks and stones above high water mark. It also grows well when transplanted to gardens. On the coast of North America it is not found higher than the south of Florida, from whence its seeds have doubtless originally come along the course of the Gulf Stream.

POINCIANA PULCHERRIMA, *L.* Hab. Tropics of both hemispheres.

P. REGIA. *Bot. Mag.* Hab. Madagascar.

CASSIA BACILLARIS, *L.* Hab. West Indies and central America.

C. glauca, *Lam.* (C. Plumieri, *D. C.*—C. planisiliqua, *Lam.* —C. arborescens, *V.*—C. sulfurea, *D. C.*—C. discolor, *Desv.*) Hab. Tropics of both hemispheres.

C. florida, *V.* (C. gigantea, *Berter.*—C. arborea, *Macf.*)

Tamarindus indica, *L.* (T. occidentalis, *G.*) "Tamarind tree." Hab. East Indies. Several fine trees grow in different parts of the islands.

Hymenæa Courbaril, *L.* "Locust-tree." Hab. West Indies and central America. A fine specimen grows on Mr. Somers Tucker's farm in Smith's parish. Another fine example of this noble tree grew on the Cavendish estate, the property of Chief Justice Darrell. Under the branches of this tree the celebrated Wesleyan minister Whitfield used to preach to the people when refused the pulpits of the English churches by Governor Popple in 1748. It was blown down during the heavy gale of Oct. 31, 1847, but a stone slab marks the spot where it grew.

Bauhinia ——?

Detarium senegalensis, *D. C.* Hab. Western Africa.

Mimosa pudica, *L.* Hab. Tropics of both hemispheres.

Acacia paniculata, *Willd.* (A. microcephala, *Rich. Cub.*—A. Clauseni, *Benth.*—A. martinicensis, *Prl.*) Hab. West Indies and S. America. From the seeds of the common acacia which has become a perfect nuisance in many parts of the islands, are made very pretty baskets, necklaces, bracelets, &c. The seeds are first soaked in water and then threaded with a needle. The seeds are ripe about September.

Inga vera, *Willd.* (Mimosa Inga, *L.*) Hab. West Indies.

Ceratonia siliqua, *D. C.* "Carob-tree." Hab. Levant.

CHRYSOBALANEÆ.

Chrysobalanus Icaco, *L.* "Fat Pork Tree" of Barbados. Hab. Tropics of both hemispheres.

AMYGDALEÆ.

Armeniaca vulgaris, *D. C.* "Apricot." Hab. Levant.

Amygdalus persica, *D. C.* "Peach."

var. nectarina. "Nectarine."

PYRUS MALUS, *L.* "Apple." Hab. Britain. Although the apple tree bears fruit, it is of inferior growth and flavour compared with that grown in northern latitudes.

PRUNUS —— ? Varieties cultivated.

CYDONIA VULGARIS, *Jacq.* Hab. S. Europe.

ROSACEÆ.

SPIRÆA SALICIFOLIA, *L.* Hab. Britain.

FRAGARIA VIRGINIANA, *Ehr.* Hab. N. America.

RUBUS —— ?

ROSA —— ? Perhaps in no country in the world does the rose in its several varieties thrive and blossom in greater perfection than in the Bermudas. Both standard and climbing roses are extremely common, and of the most luxuriant growth. One exception, however, must be made; the moss rose is a perfect failure. From what cause it is difficult to imagine, but perhaps the failure of the fuchsia also may arise from the same circumstance.

POMACEÆ.

ERIOBOTRYA JAPONICA, *D. C.* Hab. Japan. "Loquat." Very common in gardens.

CRATÆGUS —— ?

SPIREACEÆ.

SPIRÆA JAPONICA. Hab. Japan.

MYRTACEÆ.

JAMBOSA VULGARIS, *D. C.* (Eugenia jambos, *L.*) Hab. East Indies.

EUGENIA UGNI ? "Myrtle."

ANAMOMIS FRAGRANS, *Gr.* (Myrtus, *Sw.*—Eugenia, *W.*) Hab. West Indies.

PIMENTA VULGARIS, *W. A.* (Myrtus Pimenta, *L.* — Eugenia Pimenta, *D. C.*) "Allspice." Hab. W. Indies. A fine tree grows on the estate of the late Sir William Burnaby.

PSIDIUM GUAVA, *Radd.* (P. pomiferum, *L.*—P. pyriforme, *L.* —P. fragrans, *Macf.*) "Guava." Hab. West Indies.

MYRTUS COMMUNIS, *Lam.*

LYTHRARIEÆ.

Lythrum —— ?

TAMARISCINEÆ.

Tamarix gallica, *Rœm* et *Schult.* "Spruce." Common on the north shore near the Flatts.

ONAGRARIEÆ.

Fuchsia —— ? Hab. Mexico; Chili. The climate of the Bermudas appears to be unfavourable to the growth of the fuchsia, as it will not blossom freely unless placed in a sheltered situation, which is a singular fact, when we consider that in Madeira which is in precisely the same latitude though far to the eastward, the fuchsia grows in the wildest profusion.

RHIZOPHORACEÆ.

Rhizophora mangle, *L.* (R. racemosa, *Mey.*) "Mangrove." Hab. Shores of the warmer regions of the globe. Perhaps the most extensive mangrove swamp in the Bermudas is at Hungary Bay, Devonshire Parish. On the opposite coast of N. America, the mangrove does not occur farther north than the south of Florida.

COMBRETACEÆ.

Conocarpus erectus, *L.* Hab. Tropics of both hemispheres. Called "Button-wood" in Jamaica. In mangrove swamps.

C. racemosus.

Terminalia catappa, *L.* Hab. Tropics of Asia and Africa. "Indian Almond-tree" of the West Indies.

LAURACEÆ.

Persea gratissima, *G.* "Avocada Pear" "Alligator Pear."

Laurus nobilis. "Bay-tree."

Oreodaphne —— ?

CUCURBITACEÆ.

Bryonia —— ?

Cucumis sativus, *D. C.* "Cucumber." Varieties cultivated. Hab. East Indies.

C. citrullus, *D. C.* "Water Melon." Hab. Africa.

C. MOSCHATA, *D. C.* "Musk Melon." Hab. W. Indies.

LAGENARIA —— ? "Gourd." Hab. Asia. Varieties cultivated.

PAPAYACEÆ.

CARICA PAPAYA, *L.* "Papaw." Hab. All tropical countries. The fruit is used as a vegetable, and the leaves are said to possess the peculiar property of rendering tender in a few hours the toughest meat wrapped up in them.

PASSIFLORACEÆ.

TACSONIA —— ?

PASSIFLORA CÆRULEA, *D. C.* Hab. S. America.

P. LAURIFOLIA, *D. C.* Hab. West Indies.

P. QUDRANGULARIS, *L.* "Grenadilla Vine." Hab. W. Indies and tropical America.

CACTACEÆ.

MELOCACTUS COMMUNIS, *D.C.* (Cactus Melocactus, *L.*) "Turk's Head." Hab. West Indies.

CEREUS TRIANGULARIS, *Haw.* Hab. W. Indies and central America.

C. GRANDIFLORUS, *Haw.* "Night-blooming Cereus." Hab. W. Indies.

OPUNTIA TOMENTOSA, *D. C.* "Tall Prickly Pear." Hab. South America.

O. TUNA, *Mill.* "Small Prickly Pear." Hab. West Indies, flowers May. Very common.

O. COCCINELLIFERA, *Mill.* "Cochineal-plant." Hab. W. Indies and central America.

PIERESCIA ACULEATA, *Mill.* (Cactus Pereskia, *L.*) "Barbados Gooseberry."

CRASSULACEÆ.

BRYOPHYLLUM CALYCINUM, *Salisb.* "Life Plant." Hab. Tropics of both hemispheres.

ECHEVERIA SANGUINEA.

E. METALLICA.

RIBES GROSSULARIA, *Rœm* et *Sch.* "Gooseberry."

R. RUBRUM, *D. C.* "Red Currant."

Kalanchoe —— ?

Sedum acre, *D. C.* Hab. Britain.

Sempervivum —— ?

SAIFRAGACEÆ.

Hydrangea hortensis, *D. C.* Hab. China.

ARALIACEÆ.

Aralia —— ?

Hedera helix, *L.* "English Ivy."

UMBELLIFERÆ.

Daucus —— ?

Pastinaca sativa, *D. C.* "Parsnip." Hab. S. Europe. Grows well.

Thaspium —— ? "Alexander." This plant is useful in liver complaints, the root being made either into poultices to allay inflammation, or infused and the liquid drank. The seeds are boiled and the decoction used as a draught to cleanse the liver. Horses are fond of the plant in its green state.

Apium graveolens, *L.* "Celery." Hab. Britain. Grows well.

Helosciadium leptophyllum, *D. C.* (Sison Ammi, *Jacq.*—Pimpinella laterifolia, *L.*) Hab. S. Europe.

Petroselinum sativum, *D. C.* "Parsley." Hab. Sardinia. Grows in perfection in winter and spring, but dies off in the hot summer months.

CAPRIFOLIACEÆ.

Caprifolium ——? "Honeysuckle."

Lonicera —— ? "Fly Honeysuckle."

Sambucus nigra, *L.* "Elder." Hab. Britain.

Viburnum Tinus, *D. C.* "Laurestine." Hab. S. Europe. Flowers in January.

RUBIACEÆ.

Randia latifolia, *Lam.*? "Box." Hab. West Indies. Grows in abundance on the ridge above the Paget Sand Hills.

GARDENIA FLORIDA, *D. C.* "Cape Jasmine." Hab. China.

G. FORTUNII.

G. NITIDA.

RONDELETIA ODORATA, *Jacq.* Hab. Cuba.

RHACHICALLIS RUPESTRIS, *D. C.* (Hedyotis americana, *Jacq.*—H. rupestris, *Sw.*—Buchnera, *Sw.*) Hab. W. Indies.

CEPHALANTHUS OCCIDENTALIS, *D. C.* "Button wood." Hab. S. States. In marshes. The bark and leaves are used for tanning. Among the old acts of the Bermudian Parliament is one passed in the year 1704 for the protection of the Button-wood which must then have been highly prized. The penalty for destroying button wood was fixed at twenty shillings for each offence, "or the value thereof in good tobacco of the islands."

CHIOCOCCA RACEMOSA, *Jacq.* "Blolly Snowberry." Road side, near Tucker's Town.

IXORA JAVANICA.

I. FLAMMEA, *D. C.* (I. stricta *Roxb.*—I. speciosa, *Willd.*)

I. AMBOYENSIS.

I. ACUMINATA, *D. C.* The Ixoras are natives of tropical Asia.

COFFEA ARABICA, *L.* (C. guianensis, *Sieb.*) "Coffee." Hab. Eastern tropical Africa. Grows wild about Walsingham and different parts of the Islands. No attention is paid to its cultivation.

BORRERA —— ?

VALANTIA MURALIS, *D. C.* Hab. S. Europe.

VANGUERIA EDULIS, *D. C.* Hab. East Indies.

COMPOSITÆ.

EUPATORIUM FOENICULACEUM, *Willd.* "Dog fennel." Waste ground which has been cultivated. A common weed.

ASTER TRIPOLIUM. Hab. Britain. Road sides, common. Fl. April.

ERIGERON PHILADELPHICUM, *L.* (E. purpureum, *Ait.*) Fleabane." Hab. N. America.

SOLIDAGO —— ? Low ground.

BACCHARIS —— ? n. sp. Pembroke Marshes.

AMBROSIA HETEROPHYLLA, *D. C.* Hab. N. America.

ZINNIA ELEGANS, *D. C.* Hab. Mexico.

PYRETHRUM PARTHENIFOLIUM, *D. C.* Hab. Caucasus.

GAZANIA SPLENDENS. Hab. C. G. H.

HELIANTHUS —— ?

BIDENS —— ?

ARTEMISIA —— ?

SENECIO VULGARIS, *L.* "Groundsel." Hab. Europe.

CENTAUREA GYNOCARPA..

CICHORIUM INTYBUS, *D. C.* "Succory." Hab. Europe. A common weed, much relished by pigs. Fl. May.

TARAXICUM DENS LEONIS, *Desf.* Hab. Europe. "Clock."

LACTUCA SATIVA, *L.* "Lettuce." Varieties cultivated.

SONCHUS —— ?

SYNANTHEREÆ.

BORRICHIA ARBORESCENS, *D. C.* (B. frutescens jamaicense, *L.* —B. argentea, *D. C.*) Hab. West Indies. Among rocks, south shore.

LOBELIACEÆ.

LOBELIA —— ?

GOODENOVIEÆ.

SCÆVOLA PLUMIERI, *L.* (Lobelia *L.*—Scævola Lobelia, *Sw.*—S. Thunbergii, *Eckl.*—S. senegalensis, *Prl.*) Hab. Tropics of both hemispheres.

ERICACEÆ.

AZALEA —— ? Varieties cultivated.

ILICINÆ.

ILEX AQUIFOLIUM, *L.* "Holly." Hab. Britain.

I. VOMITORIA, *D. C.* Hab. Florida.

URTICACEÆ.

FICUS ELASTICA, *Humb.* et *Bonp.* "India-rubber Tree." Hab. East Indies. A fine example grows in front of the late Mr. Perot's residence in Hamilton. Also at Mount Langton, where the remarkable extent of the lateral roots is observable on the hill-side above the garden.

ARTOCARPUS INCISA, *Willd.* "Bread Fruit." Hab. Pacific and East Indian Islands.

A. INTEGRIFOLIA, *Willd.* "Jack Fruit." Hab. Pacific and East Indian Islands.

MORUS ALBA, *Willd.* "Mulberry." Hab. China.

M. NIGRA, *Willd.* Hab. Italy.

PILEA MICROPHYLLA, *Liebm.* (Parietaria *L.*—Urtica, *Sw.*—Pilea muscosa, *Lindl.*) Hab. West Indies and Central America.

BŒHMERIA CYLINDRICA, *Willd.* (Urtica *L.*—U. reticulata, *Sw.*—Bœhmeria litoralis, *Sw.*—B. lateriflora, *Muhl.*)

URTICA DIOICA, *L.* "Stinging Nettle." Hab. Europe.

ARTOCARPEÆ.

MACLURA AURANTIACA, *Nutt.* Hab. N. America.

ULMACEÆ.

CELTIS OCCIDENTALIS, *L.* "Nettle-tree." Hab. Southern States of America.

PLATANACEÆ.

PLATANUS OCCIDENTALIS, *L.* Hab. Southern States of America.

CUPULIFERÆ.

QUERCUS NIGRA, *L.* Hab. N. America.

PRIMULACEÆ.

ANAGALLIS ARVENSIS, *L.* "Pimpernel." Hab. Europe. This widely distributed species is a very common weed in gardens, and other places which have been cultivated. Large masses of this plant may be seen in flower beneath the cliffs on the south shore of Smith's parish, in Feb., Mar., and April.

PRIMULA SINENSIS, *Lindl.* "Chinese Primrose."

MYRSINACEÆ.

ARDISIA ACUMINATA, *Willd.* (Icacorea guianensis, *Aubl.*—Ardisia semicrenata, *Mart.*)

A. HUMILIS, *Vent.* (A. solonacea, *Roxb.*) Hab. East Indies.

SAPOTACEÆ.

CHRYSOPHYLLUM CAINITO, *L.* "Star Apple." Hab. West Indies and Tropical America.

SAPOTA ACHRAS, *Mill.* (Achras sapota, *L.*) "Sappodilla." Hab. Tropics of both hemispheres. Grows well in the Bermudas, and the fruit attains a large size, sometimes 13 ozs. in weight.

LUCUMA MAMMOSA, *G.* (Achras, *L.*) "Mammee Apple. Hab. W. Indies and Tropical America.

EBENACEÆ.

DIOSPYROS MABOLA, *Don.* Hab. Phillipines.

D. VIRGINIANA, *Willd.* Hab. Southern States of America.

OLEACEÆ.

OLEA EUROPÆA, *G. Don.*, *var.* longifolia. "Olive." Hab. S. Europe. Common in different parts of the islands. A "wild olive" is mentioned by the early settlers as being abundant about the islands.

LIGUSTRUM VULGARE, *L. var.* sempervirens. Hab. Italy.

JASMINACEÆ.

JASMINUM OFFICINALE, *L.* Hab. East Indies. Very common among the rocks and mouths of caves at Walsingham.

J. FRUTICANS, *G. Don.* Hab. S. Europe.

J. GRACILE, *Andr.* (J. volubile, *Jacq.*) Hab. Pacific Islands.

J. SAMBAC, *G. Don.* Hab. East Indies.

APOCYNACEÆ.

THEVETIA NERIIFOLIA, *Juss.* (Cerbera Thevetia, *L.*) "Yellow-trumpet flower." "French Willow" of Barbados. Hab. West Indies and tropical America.

VINCA ROSEA, *L.*? Hab. Tropics of both hemispheres.

PLUMIERIA RUBRA, *L.* "Red Jasmine." Hab. Central America.

NERIUM OLEANDER, *L.* "Oleander." Hab. S. Europe. Very common all over the islands. There is an old lady now living, 90 years of age, who well recollects when a school girl eighty years ago, going to see as a curiosity the only oleander tree then known in the Bermudas. It grew on the estate of Mr. Burch, near the parish church of Warwick. There is a curious idea prevalent among the islanders, that water left standing beneath an oleander tree is poisonous to poultry drinking it, and also that crab grass which generally grows luxuriantly under its shade, is poisonous to cattle, an effect certainly not applicable in all cases, as we have allowed a horse to graze at will beneath these trees without any bad results. The oleander is now extensively used for hedging about cultivated ground to keep off the violence of the winter gales from the crops, and as it grows from cuttings very quickly to a good height, and from the flexible nature of its branches is never broken by the wind, it proves an excellent screen. About the middle of March it puts forth its lovely blossoms in vast profusion, and fields and roadsides present a glorious floral scene. The oleander has one great drawback, however, in the great length to which its roots extend, encroaching sadly upon the land it shelters. This we think might be prevented by trenching at about three feet from the stem. The flexible branches are used extensively for hooping up barrels in which potatoes are exported. There are three varieties; the common or single rose coloured, the double rose, and the white.

STEPHANOTIS. FLORIBUNDA, *Bot. Reg.* Hab. S. America.

ASCLEPIADACEÆ.

ASCLEPIAS CURASSAVICA, *L.* "Silkweed." "Ipecacuanha." Hab. Originally a S. American form, this plant has become a weed in all tropical countries. It is very common throughout the Bermudas, its leaves forming the only food of the caterpillar of *Danais archippus.* It is in blossom nearly every month of the year.

HOYA CARNOSA, *G. Don.* Hab. Asia.

ORBEA MACULOSA, *G. Don.* Hab. C. G. H.

GENTIANACEÆ.

ERYTHRÆA RAMOSISSIMA, *Pers.* "Rice Plant." Hab. Europe.

A very common weed. The plant is sometimes used to make bitters, and tea made from it is said to afford relief in cases of colic.

CONVOLVULACEÆ.

IPOMÆA BATATAS, *Lamx.* (Convolvulus *L.*—Batatas edulis, *Chois.*) "Sweet Potato." Varieties cultivated. Hab. America.

I. NIL, *Kth.* (I. hederacea, *Jacq.*—Convolvulus Nil, *L.*—Pharbitis Nil, *Chois.*) Hab. Tropical America.

I. QUAMOCLIT, *L.* (Quamoclit vulgaris, *Chois.*) Hab. Tropics of both hemispheres.

I. COCCINEA, *L.* (Quamoclit coccinea, *Moench.*) Hab. W. Indies and South America.

I. LERII.

BORRAGINACEÆ.

CORDIA SEBESTENA, *Jacq.* (C. speciosa, *Willd.*) "Scarlet Cordia." Hab. West Indies and tropical America.

TOURNEFORTIA LAURIFOLIA, *Vent.* (T. syringifolia, *V.*—T. Sagræana, *D. C.*—T. surinamensis, *D. C.*)

HELIOTROPIUM PERUVIANUM, *G. Don.*

H. CURASSAVICUM, *L.* Hab. Western America.

BORAGO OFFICINALIS, *G. Don.*

LABIATÆ.

OCIMUM BASILICUM, *L.* "Basil." Hab. Tropical Asia and Africa. This plant according to old records was grown from seed by the early settlers in 1615.

MENTHA ARVENSIS, *L.* "Field Mint." Hab. Europe.

M. ROTUNDIFOLIA, *Sw.*

M. VIRIDIS, *Willd.*

SALVIA SPLENDENS, *G. Don.*

S. COCCINEA, *L.* "Nip."

S. OFFICINALIS, *L.*

NEPETA —— ? "Catnip."

SCUTELLARIA —— ?

LAVANDULA SPICA, *L.* "Lavender."

COLEUS —— ? Varieties cultivated.

THYMUS VULGARIS, *L.* "Thyme."

ROSMARINUS OFFICINALIS, *G. Don.* "Rosemary."

ANETHUM FŒNICULUM, *L.* "Fennel." Grown from seed by the early settlers in 1615..

HYDROPHYLLACEÆ.

NEMOPHILA INSIGNIS, *G. Don.*

N. MACULATA.

POLEMONIACEÆ.

PHLOX DRUMMONDII, *G. Don.* Hab. Texas.

SOLANACEÆ.

SOLANUM NIGRUM, *L.* Hab. Europe.

S. TORVUM, *Sw.* (S. ferrugineum, *Jacq.*) Hab. Tropics of both hemispheres.

S. OVIGERUM, *L.* "Egg Plant." Hab. Arabia.

S. TUBEROSUM, *L.* "Irish Potato." Varieties cultivated.

CAPSICUM ——? Varieties cultivated.

PHYSALIS LANCEOLATA, *Michx.* (P. Elliotii, *Kunz.*—P. maritima, *Curtis.*) Hab. S. States of America.

P. PERUVIANA, *L.* (P. pubescens, *R. Br.*—P. edulis, *Sims.*) Hab. Warmer countries of the globe. The berry of this species is known as the "Cow-cherry."

DATURA STRAMONIUM, *L.* "Stinking-weed." Hab. Temperate and tropical countries. Common in waste ground that has been cultivated. In yellow fever cases the leaves, first sprinkled with vinegar, are used to apply to the wrists to cool the patient.

D. METEL, *L.* Hab. Warmer regions of Africa and America.

D. SUAVEOLENS, *Humb.* et *Bonpl.* (Brugmansia, *G. Don.*—Datura arborea, *Hort.*—D. Gardneri, *Hook.*) Hab. West Indies and tropical America.

D. FASTUOSA, *L.* Hab. Tropical regions of both hemispheres.

NICOTIANA TABACUM, *L.* "Tobacco." Hab. America. Previous to the more extensive settlement of the Colony of Virginia, tobacco was cultivated to a considerable extent in the Bermudas; but when the former colony began its career of tobacco culture, the extent of country and fertility of soil enabled the Virginians to eclipse the Bermudians in this profitable trade, which gradually declined in the islands, and has never been attempted since. In the year 1670 one ship received as part of her cargo for England, 250,000 lbs. It is stated, with what truth we know not, that tobacco plants are sure to spring up where old stone walls are taken down.

PETUNIA ——? Varieties cultivated.

SCROPHULARIACEÆ.

BUDDLEJA AMERICANA, *L.* (B. occidentalis, *R. P.*) "Snuff-plant. Hab. Western part of America, California to Peru. The odor of this shrub is very powerful and unpleasant, and it should never be allowed to grow in any quantity by the public roadside, as it is in Paget parish near the "Head of the Lane." Fl. Jan.

B. MADAGASCARIENSIS, *G. Don.*

VERBASCUM THAPSUS, *L.* "Dock-leaves." Hab. Europe. The common mullein adds not a little to the scenic effect of the flora of the Bermudas; for where such a paucity of wild flowers exists, its noble spike of yellow bloom rising full five feet high in good ground, presents a peculiarly pleasing effect, and recalls home scenes in days gone by, while rambling amid the sunny glades of old England. The woolly leaves are used by cottagers for cleaning plates and dishes.

LINARIA VULGARIS, *Mill.* Hab. Europe. Very common in gardens and waste land which has been cultivated. It is much smaller than the northern form.

ANTIRRHINUM ——? Varieties cultivated.

VERONICA SALICIFOLIA.

CAPRARIA BIFLORA, *L.* Hab. Tropical Africa and America.

RUSSELLIA JUNCEA, *Bot. Reg.* "Heath." Hab. Mexico.

MAURANDIA BARCLAYANA, *G. Don.*

M. SEMPERFLORENS, *G. Don.*

M. ——?

BIGNONIACEÆ.

CRESCENTIA CUJETE, *L.* "Calabash." Common in low grounds. The shells are made into cups and dippers.

C. CUCURBITINA, *L.* Not common.

CATALPA ——?

TECOMA PENTAPHYLLA, *D. C.* (Bignonia, *West.*) "White Cedar." Hab. West Indies and Central America.

T. CAPENSIS, *G. Don.* Hab. C. G. H.

T. RADICANS, *Juss.* (Bignonia radicans, *L.*) Hab. N. America.

T. STANS, *Juss.* (Bignonia, *L.*—Tecoma sambucifolia, *Kth.*)—Hab. West Indies and Central America. The Tecomas are known as "Trumpet-flowers."

BIGNONIA CHERERE, *G. Don.* (B. heterophylla, *Willd.*) Hab. S. America.

B. VENUSTA, *G. Don.* Hab. S. America.

B. OBLIQUA.

ACANTHACEÆ.

THUNBERGIA ALATA, *Bot. Mag* Hab. Eastern Africa.

T. ——?

JUSTICIA ALBA, *Roxb.*?

J. ——?

J. ——?

GESNERIACEÆ.

ACHIMENES ——?

VERBENACEÆ.

VERBENA ——? Varieties cultivated.

ALOYSIA CITRODORA, *Pers.* (Verbena triphylla, *Bot. Mag.*—Lippia citrodora, *Kth.*)

STACHYTARPHA JAMAICENSIS, *V.* "Vervain;" supposed from the Celtic "Ferfaen." One of the more common weeds. In rich ground it grows quite shrubby two or three feet high. It is useful in cases of yellow fever, the plant being boiled for tea, which given to the patient promotes perspiration. In flower all winter.

LIPPIA REPTANS, *Kth.*

Lantana odorata, *L.* (L. recta, *Ait.*—L. peduncularis, *Anders.*) Hab. West Indies and Central America. This shrub also grows on the Galapagos Islands. It forms the principal underwood of the Bermudas, clothing every spot of waste ground, for wherever the land remains uncultivated, or more particularly where the cedar groves are not properly cleared, this shrub is sure to spring up and increase rapidly. It has no beauty to recommend it, and its brittle stems are of little use save for fuel and placing as supports for the tomato vines to run over; a process very commonly resorted to by the farmers of the present day; but one only commendable for the service it renders towards annihilating this worthless form. The leaves are said to be a febrifuge in yellow fever cases; tea made from them, when taken hot, promoting perspiration in a high degree.

L. Camara, *L.*? (L. aculeata, *L.*) "English Sage." "Red Sage-bush." Hab. North and South America; Southern States to Buenos Ayres. This species which a few years ago was confined to a few localities, is now fast spreading over the Islands. It grows much more luxuriantly in shady places, particularly in cedar groves occupying rich ground. In such places it will run up among the branches of the cedars to the height of 20 or 30 feet. On the eastern and western sides of Prospect Hill it forms dense thickets.

Citharexqylum quadrangulare, *Jacq.* (C. caudatum, *Sw.*—C. coriaceum, *Desf.*) "Fiddle-wood." Hab. West Indies and Central America. It would be well for the scenery of the Bermudas if this tree was more generally grown, for when mingled with the all-prevailing cedar it helps to render the landscape less monotonous. But slight difference exists between this form and *C. cinereum*, L.

Duranta Plumieri, *Jacq.* (D. Ellisia, *Jacq.*—Ellisia acuta, *L.*) Hab. West Indies and tropical America.

Petræa arborea, *Kth.* Hab. W. Indies and tropical America.

Clerodendron capitatum.

Avicennia nitida, *Jacq.* "Black Mangrove." Hab. Tropical Africa and America.

PLANTAGINACEÆ.

Plantago major, *L.* "English Plantain." Hab. Europe. Common about the sides of the marshes.

P. lanceolata, *L.* "Ribwort." Hab. Europe. A common weed in high ground. Horses are very fond of it.

P. Rugelii, *Dec.*? Hab. Southern States of America. Rare high and rocky ground.

PLUMBAGINACEÆ.

Plumbago capensis, *Rœm* et *Schult.* Hab. C. G. H.

CHENOPODIACEÆ.

Chenopodium Anthelminticum, *L.* Hab. United States to S. America.

Salicornia ambigua, *Michx.* Hab. North America.

Basella cordifolia, *Rœm* et *Schult.* Hab. East Indies.

AMARANTACEÆ.

Amarantus ——? Varieties cultivated.

Alternanthera ——? Varieties cultivated.

Iresine Herbesti.

NYCTAGINACEÆ.

Mirabilis longiflora, *Rœm* et *Schult.* Hab. Mexico.

Oxybaphus ——? "Four o'clock." Hab. N. America. Common about old ruined houses.

POLYGONACEÆ.

Rumex ——? The root of the "dock" is used medicinally, being found of service in cholera complaints.

Rheum rhaponticum, *L.* "Rhubarb." Hab. Asia. General Lefroy introduced this useful plant last year (1872) in the garden at Mount Langton, and a bunch was exhibited at the Industrial Exhibition at St. George's, last May (1873.)

Polygonum platyphillum.

Coccoloba uvifera, *Jacq.* "Sea-side Grape." Hab. Florida to Guiana. Common in sandy places near the shore.

PIPERACEÆ.

Piperomia ——?

EUPHORBIACEÆ.

Euphorbia buxifolia, *Lam.* "Tittimelly." Hab. Tropical America.

E. candelabra.

E. heterophylla, *L.* Hab. North and South America.

E. maculata, *L.* (E. Burmanniana, *Gay.* — E. thymifolia, *Pursh.*—E. depressa, *Torr.*) Hab. North and South America.

E. splendens, *Hook.* Hab. Madagascar.

Jatropha multifida, *L.* "Coral-tree." "Physic Nut." Hab. West Indies and tropical America.

Janipha Manihot, *Kth.* (Jatropha, *L.* — Manihot Aspi *et* utilissima, *Pohl.*) "Cassava." Hab. West Indies and tropical America. The climate and soil of the Bermudas are very favourable to the growth of the Cassava, roots of one year's growth having been taken up six feet long and three inches in diameter, and weighing 22 lbs. It is prepared much like arrow-root, and is perhaps superior to that article as food for invalids, when the preparatory process has been conducted with care. The manufacture is tedious, and probably for this reason but a small quantity is made, barely sufficient for the requirements of the inhabitants.

Aleurites triloba, *Forst.* Hab. East Indies.

Ricinus communis, *L.* "Castor-oil tree." Hab. East Indies.

Croton discolor.

C. variegata. Hab. East Indies.

Hura crepitans, *L.* "Sandbox tree." Hab. West Indies and tropical America. A fine specimen grows in old Government House garden, St. George's.

Pedilanthus tithymaloides, *Poit.* (P. carinatus, *Spr.*—Euphorbia carinata, *Bot. Mag.*)

Stillingia sebifera, *Michx.* Hab. China.

Poinsettia pulcherrima, *Bot. Mag.* "Fire Plant."

BEGONIACEÆ.

BEGONIA FUCHSIOIDES.
B. HYDROCOTYLÆFOLIA, *Hook.* Hab. Brazil.
B. REX.

JUGLANDACEÆ.

JUGLANS NIGRA, *L.* "Black Walnut." Hab. N. America.

SALICACEÆ.

SALIX BABYLONICA, *L. var.* Napoleana. Hab. Levant.
S. ———?
POPULUS ALBA, *L.* Hab. Europe.

CONIFERÆ.

JUNIPERUS BARBADENSIS, *L.* (J. bermudiana, *Lun.*) Hab. West Indies. [Combined by Endlicher with *J. virginiana*, L., which is quite distinct by having a short gland and no linear furrow on the back of the leaves, and by the galbuli ovate-obtusate. Note, Grisebach, W. I. Flora, p. 503.] The Bermudian cedar has generally been considered as identical with, or merely a variety of, the Virginian cedar, which form in its several varieties is found throughout the eastern portion of the North American continent. Grisebach's identification therefore bears out our theory that these islands owe more to the current of the Gulf Stream and the prevailing southerly winds for their vegetation than other causes. A few drift seeds of this cedar germinating, and the plants attaining maturity at any point of the shore, judging from the extraordinary abundance of young plants springing up annually on every spot of ground left uncultivated, would soon over-run the group; a circumstance only too notorious at the present day. The attachment of the Bermudians to this their only forest tree is great, so much so that a large extent of the richest land upon the islands has from time immemorial been devoted to the growth of cedar alone. The more extended and profitable cultivation of vegetables for the New York markets, a trade which is increasing rapidly every year, will, however, soon tend to lessen the number of cedars, an event not altogether lamentable where their preponderance, in the absence of other forms, creates a sameness painful to the eye. In former years when ship building was carried on with some spirit, the vessels were built entirely of cedar, which, from its extreme durability, was well suited for the purpose, the only drawback being its brittle character. The wood is much used also for housebuilding purposes, doors, windows, beams, rafters, &c. being made of cedar, and it is no uncommon occurrence to see window sashes fifty or more years old looking quite new in appearance. The cedar also makes excellent fencing; a post and rail fence when well made at first, lasting some forty years, and curious enough the poles, although worn by the elements to skeletons in that long course of time, yet perfectly sound at heart. There are several very aged trees now standing in different parts of the islands; that in the old churchyard of Devonshire Parish being perhaps older than any other. Cedars of very large size must have existed in years gone by on the site of the present marshes, for wherever drains or deep cuttings are made through them, huge trunks are revealed. The circumstance of cedars not being found growing in these marshes at the present day is worthy of consideration, for it tends to substantiate the generally received opinion regarding the subsidence which is known to have taken place since the formation of the group.* When the marsh land was higher than at present, a moderately dry soil existed, and upon this grew a vigorous growth of cedars, but when the land subsided and the ocean level became higher than the marsh land, salt water found its way through the caverns or underground channels, and overflowing the ground, caused it to turn into a morass entirely unsuited to the cedar, which, gradually decaying at its base, fell at length to the fury of some passing gale. The size of the cedar varies much, according to situation, as it is only in the valleys, where the richest soil exists, that the cedar attains its full dimensions; on the hill sides and coast line where they are exposed to the prevailing gales, they are stunted and in many

* See "Nature" Aug. 1, 1872.

cases contorted in form; indeed, so much so, that trees known to be thirty years old and upwards, are only a few feet in height and not more than three inches in diameter of trunk.

PINUS ——— ? Several species recently introduced by General Lefroy.

THUJA ORIENTALIS, *L.* Hab. China.

PODOCARPUS SALICIFOLIUS, *Kl. Karst.* Hab. West Indies and tropical America.

CALLITRIS VARICOSA.

CYCADACEÆ.

CYCAS REVOLUTA, *Thunb.* "Sago-Palm." Hab. China.

AROIDEÆ.

COLOCASIA ESCULENTA, *Schott.* "Eddoe." Hab. East Indies.

DIEFFENBACHIA SEQUINE, *Schott.* (Arum, *L.*—D. Plumieri, *Schott.*—D. neglecta, *Schott.*) "Dumb Cane." Hab. West Indies and tropical America.

RICHARDIA ÆTHIOPICA, *Sw.* (Calla æthiopica, *Bot. Mag.*) Hab. C. G. H.

LEMNA MINOR, *L.* "Pond Weed." Hab. Europe.

PANDANEÆ.

CARLUDOVICA INSIGNIS, *Duch.* Hab. West Indies. It is from the leaves of a species of Carludovica that the celebrated "Panama hats" are made.

PANDANUS ODORATISSIMUS, *L.* "Screw Pine." Hab. China.

P. MURICATUS, *Spreng.* Hab. Madagascar.

ARACEÆ.

CALLA ——— ?

CALADIUM ——— ?

ENDOGENS.

PALMÆ.

SABAL PALMETTO, *R. & S.* (Chamærops palmetto, *Michx.*) "Palmetto." Hab. Southern States of America. It is from the strong leaves of this tree that the well known "Mudian plait" is made. It is prepared in the following manner. The young leaves are tied about their centre to prevent them being torn into strips by the wind. When these leaves are fit for use *i. e.*, before they have grown too hard and coarse they are cut from the tree and placed in the sun to bleach. When sufficiently dry they are smoked with burnt brimstone in casks to render them white. When ready for use they are cut into strips and different forms of plait made according to taste. Of the coarser plait is made labourers' hats, the finer and more difficult of manufacture being used only for ladies' bonnets and fancy basket work, specimens of which are sometimes produced of exquisite finish.

OREODOXA OLERACEA, *Mart.* "Cabbage Palm." Rare. Hab. West Indies.

ASTROCARYUM AUREUM, *Gr.* et *Wendl.* "Gri-gri." "Gru-gru." Hab. Trinidad.

ARECA CATECHU, *L.* Hab. East Indies.

RHAPIS FLABELLIFORMIS, *Willd.* Hab. China.

COCOS NUCIFERA, *L.* "Cocoa-nut." Origin. West coast of Panama.

MARTINEZIA CARYOTÆFOLIA, *Mart.* Hab. Brazil.

PRITCHARDIA PACIFICA.

LIVISTONIA MAURITIANA.

COMMELINACEÆ.

TRADESCANTIA VIRGINICA, *L.* Hab. North America.

T. DISCOLOR, *Spreng.* Hab. West Indies.

COMMELYNA COMMUNIS, *L.* Hab. Southern States of America.

CYANOTIS DISCOLOR.

GRAMINEÆ.

ARUNDINARIA TECTA, *Muhl?* Hab. Southern States of America.

BAMBUSA VULGARIS, *Schrad.* (B. Thouarsii, *Kth.*—B. arundinacea, *Ait.*) Common in the marshes.

ALOPECURUS PRATENSIS, *Kth.* "Fox tail grass." Hab. Europe.

PANICUM MOLLE, *Sw.* "Para grass." (P. barbinode, *Tr.*—P. guadalupense, *Steud.*—P. meyerianum, *N. S.*—P. sarmentosum, *Roxb.*—P. punctulatum, *Arn.*)

P. MAXIMUM, *Jacq.* (P. jumentorum, *Pers.*—P. trichocondylum, *Steud.*—P. fasciculatum, *Pl. Carib.*) "Guinea grass." Hab. Tropical Africa.

ZEA MAYS, *Kth.* "Indian Corn." Hab. unknown, supposed to be American.

ZEA JAPONICA.

AVENA SATIVA, *L.* "Oat." Grows well for a time and then dies off before ripening seed. Oats are generally sown in ground intended for a potato crop, and when about a foot in height, are dug under in order to manure the ground for the coming crop.

TRITICUM VULGARE, *L.* "Wheat." Grows well in some places, and produces fair grain. In former years it was more extensively cultivated, and bread was frequently made in farm houses, but of late years its cultivation has ceased altogether.

HORDEUM VULGARE, *L.* "Barley." Grows well and ripens, but is seldom cultivated as a crop.

SACCHARUM OFFICINARUM, *L.* (S. violaceum, *Tuss.*) "Sugar Cane." Grows well, especially in low moist ground.

SPOROBOLUS INDICUS, *R. Br.* (Agrostis, *L.*—S. tenuissimus, *P. B.*—S. elongatus, *R. Br.*) Hab. Warmer regions of both hemispheres.

CHLORIS PETRACA, *Thunb.* (Eustachys, *Desv.*—C. Swartzii et septentrionalis, *C. Müll.*)

CYNODON DACTYLON, *Pers.* This grass is widely distributed over the tropical and temperate regions of the globe.

PASPALUM DISTICHUM, *L.* (P. litorale, *R. Br.* — Digitaria paspaloides, *Dub.*)

P. FILIFORME, *Sw.* (P. Swartzianum, *Flügg.*) Hab. West Indies.

STENOTAPHRUM AMERICANUM, *Schrk.* (Rottbællia dimidiata, *Sw.* —R. stonolifera, *Poir.* — Diastemanthe platystachys, *Steud.*) Hab. North and South America.

ANDROPOGON SCHÆNANTHUS. (Cymbopogon Schænanthus, *R. et S.*) Hab. East Indies.

PHALARIS CANARIENSIS, *Kth.* Hab. Europe.

JUNCACEÆ.

Juncus maritimus, *Lam.* "Large Marsh Rush." Very common in the wetter portions of the marshes.

LILIACEÆ.

Aloe vulgaris, *Lam.* (A. barbadensis, *Mill.* — A. perfoliata, *var.* vera, *L.*) "Aloes." This plant is considered very useful in yellow fever cases, the native nurses placing great faith in its virtues. In a wild state it is not very common, its pretty spike of yellow flowers which afford a honied treat to the children, being only seen occasionally on the sunny slopes of the southern shore. It is a native of the West Indies.

A. soccotrina, *Haw.* Hab. C. G. H.

A. lingua, *Hook.*

Gasteria obliqua, *Haw.* Hab. C. G. H

G. maculata, *Haw.* Hab. C. G. H.

Haworthia tortuosa, *Haw.* Hab. C. G. H.

Yucca serrulata, *Haw.* (Y. Draconis, *L.*—Y. aloifolia, *L.*) Hab. Southern States of America and Mexico.

Y. gloriosa, *L.* Hab. Southern States of America. "Sticker bush." "Spanish bayonet." Drifting sands of Port Royal.

Y. ———?

Agave Americana, *L.* "Bamboo." Hab. S. America. Very common. Why the islanders should call this plant "bamboo," we know not, and repeated enquiries have failed to produce any satisfactory reason for the appellation. The fibrous leaves when cut open and dried are used as scrubbers for floors, &c. Very good rope has been made from the fibre.

A. striata.

A. picta.

A. xylonacantha.

A. mexicana, *Haw.* Hab. Mexico.

Fourcroya gigantea, *Vent.* Hab. West Indies. (Agave fætida, *L.*)

Crinum cruentum, *L.* Hab. S. America.

Phormium tenax, *Willd.* Hab. New Zealand.

AMARYLLIS EQUESTRIS, *Ait.* (Hippeastrum, *Herb.*—H. occidentale, *Rœm.*—Amaryllis Belladonna, *Sw.*)

NERINE SARNIENSIS, *Herbt.* Hab. Guernsey.

N. PULCHELLA, *Hook* et *Arn.* Hab. C. G. H.

ZEPHYRANTHES ATAMASCO, *Don.* Hab. N. America.

Z. ROSEA, *Bot. Reg.* Hab. Cuba.

PANCRATIUM OVATUM.

NARCISSUS JONQUILLA, *Bot. Mag.*

SANSEVIERA GUINEENSIS, *Haw.* Hab. Eastern Africa.

ORNITHOGALUM ——?

HYACINTHUS ——?

SCILLA ——?

ALLIUM CEPA, *L.* "Onion." The cultivation of the onion occupies a large share of attention at the hands of the Bermuda planter, as the soil of the islands appears to be well suited to this vegetable, and the high price obtainable during the spring months in the New York market, renders it probably the most profitable of crops. The Bermudas, owing to their position eastward of the warm current of the Gulf Stream, have a winter climate far milder than the Southern States of the American continent, situate in the same latitude; and are moreover never visited by those sudden changes of temperature during the early spring months, which do so much damage to growing crops even in South Georgia and Florida. Once only in the memory of man have the Bermudas been visited by frost, the thermometer rarely falling below 50° even in February. The crops therefore planted in December or January, regularly attain maturity in April, the onion being ready for shipment about the first week of that month, a date far earlier than it is to be procured from the Southern States. To the Bermudas New York must therefore always look for the earliest supply of vegetables, and it will be well for the islanders to bear in mind the great necessity of maintaining a proper system of steam communication with the metropolis of the western world.

LILIUM CHALCEDONICUM.

L. CANDIDUM, *Willd.*

L. SPECIOSUM.

Asparagus officinalis, *L.*
Dracæna terminalis, *L.*
Charlwoodia australis, *Sw.*

SMILACEÆ.

Smilax ——? "Sarsaparilla."

DIOSCOREACEÆ.

Dioscorea lutea, *Mey.* (D. heptaneura, *Vell.*—D. sativa, *L.*—D. Cliffortiana, *Lam.*—D. multiflora, *Prl.*—D. altissima, *Lam.*) "Yam." Hab. West Indies and tropical America.

IRIDACEÆ.

Iris virginica, *L.* Hab. North America.
I. violacea, *Bot. Mag.* Hab. S. Europe.
Sisyrinchium Bermudiana, *L.* (S. anceps, *Cav.*—S. mucronatum, *Michx.*) Hab. Florida to the Arctic Circle.
Tritonia ——?

BROMELIACEÆ.

Pitcairnia ——?

MUSACEÆ.

Musa sapientum, *L.* Hab. East Indies. "Banana."
" " *var.* rosacea. (Mauritius.)
Two or three other varieties.
Musa paradisiaca, *L.* "Plantain." Hab. East Indies.
M. cavendishii, *Paxt.* Hab. China.
Strelitzia ——?

SCITAMINEÆ.

Hedychium elatum, *Bot. Reg.* Hab. Nepaul.
Renealmia occidentalis, *Gr.* (Alpinia, *Sw.*—A. jamaicensis, *Gartn.*) "Shell Plant." Hab. West Indies and tropical America.
Canna indica, *L.* "Indian Shot." Hab. West Indies and tropical America.
C. coccinea, *Ait.* (C. occidentalis, *Rox.* — C. surinamensis, *Miq.*) "Scarlet Indian Shot."
Maranta arundinacea, *L.* "Arrow-root." Hab. West Indies and tropical America. The culture of the arrow-root which

has rendered the name of Bermuda so familiar in English homes is rapidly declining owing to the cultivable ground being required for the growth of onions, potatoes, tomatos, and other vegetables for the American markets. The arrow-root, although a valuable crop, requires much labour, and above all, occupies the ground for nearly a year, during which time the planter could raise from the same ground two heavy crops of vegetables, so that it is easy to understand why the growth of arrow-root should receive so little attention at the present day. There are some planters, however, who having obtained celebrity in the manufacture of arrow-root, continue its cultivation, and to these estates the public must principally look for a supply. The name of Bermuda is doubtless often made use of by unprincipled dealers both in Europe and America to promote the sale of the far inferior article made in the West Indian islands, for it is quite impossible that the comparatively small exportation of arrow-root from the Bermudas at present can be equal to the demand for the "Bermudian arrow-root," even in Great Britain alone. Much of the Bermudian arrow-root of the finest quality is rendered most unpalatable through the strange practice of packing it in boxes made of pine, which, even in a few days. imparts the disagreeable turpentine odour peculiar to that kind of wood. If the boxes were made of well seasoned oak, which could be easily procured of any degree of thickness from the United States, this sad mistake, which, singularly enough has been continued for years, would be rectified.

ORCHIDACEÆ.

VANILLA PLANIFOLIA, *Andr.* Hab. Tropical America.
ONCIDIUM ——— ?

FILICES.

POLYPODIACEÆ.

ACROSTICHUM AUREUM, *L.* "Great Marsh Fern." Hab. Coast of South Florida. Very common all over the marshes.

POLYPODIUM PECTINATUM, *L.* Hab. West Indies.

PTERIS AQUILINA, *L.* Hab. Europe. This form which is common all over North America is equally so in the marshes of Bermuda, where with the sedge and dog-bush it forms dense thickets, making a noble covert for the rails and galinules that visit the islands in the winter season.

ADIANTUM CAPILLUS-VENERIS, *L.* Hab. Europe. "Maiden-hair." Grows in profusion in all the shady nooks and corners of the rocks, old buildings, &c. Caverns have their entrances lined with this pretty form, and even the road side ditches are draped with its delicate fronds.

A. FARLAYENSE.

A. CUNEATUM, *Spreng.* Hab. Brazil.

ASPLENIUM BIJIDA.

A. CICUTARIUM, *Haw.* Hab. S. America.

A. MONANTHEMUM, *Willd.* Hab. C. G. H.

A. SHEPHERDII, *Spreng.* Hab. East Indies.

CYSTOPTERIS ———?

ASPIDIUM ACULEATUM, *Sw.* Hab. Temperate and tropical regions.

A. PATENS, *Sw.* (A molle, *Kunz.*)

A. MOLLE, *Sw.* (A. sclerophyllum, *Ent.*—A tetragonum, *Hook.*) Hab. All tropical countries.

A. EXALTATUM, *Sw.* (Polypodium, *L.* — Nephrolepis, *Schott.*) Hab. Tropics of both hemispheres.

ONYCHIUM JAPONICUM.

OSMUNDA REGALIS, *L.* (O. spectabilis, *Willd.*) Hab. Europe and America.

O. CINNAMOMEA, *L.* Hab. N. America.

O. PALUSTRIS.

NOTE.—In the "Annales du Museum d' Histoire Naturale" for 1807, occurs a very interesting account of the unintentional visit of the celebrated French botanist Francis Andre Michaux to the Bermudas, He set sail from Bourdeaux on Feb. 5, 1806 for Charleston, his intention being to explore the Southern States of America. On March 23, the vessel was captured by H. M. S. "Leander," and sent to Halifax, Michaux being the only passenger, who was allowed the privilege of going on board the Leander, where he seems to have received every attention from Captain Wetheby, her commander. Arriving at the Bermudas on April 7, they remained there eight days, and Michaux was allowed to go on shore. He gives a fair account of the general appearance of the islands, but his flora is very meagre, only comprising the following species: *Juniperus Bermudiana; Verbascum thapsus; Anagallis arvensis; Leontodon taraxacum; Plantago major; Urtica urens; Gentiana nana; Oxalis acetosella.* The "Sage bush" is mentioned, but not identified; also a species of *Verbena* and a *Medicago.* He appears to have regretted his inability to procure ripe berries of the cedar owing to his visit being during the flowering season, as it was his desire to have introduced the tree into the island of Corsica and the southern departments of France which border upon the Mediterranean.

Art. VII. The Grouping of the Pictou Coal Seams. By Edwin Gilpin.

(*Read March* 10, 1873.)

Our knowledge of the Pictou Coal field was for many years confined to the district worked by the General Mining Association, the south crop of the Pictou great seams. The crops of the main and deep seams had been carefully proved by the Agents of the Company, and elaborate analyses made, but their explorations had never been pushed to the west of McCulloch's Brook, and it was considered that the disturbances met there threw the seams out of the miners' reach. In accordance with the generally accepted theory, the seams underlay the town of New Glasgow at an inaccessible depth, and were covered by the measures of the Upper Carboniferous.

When the monopoly ceased in 1858, it was believed that the lines of the General Mining Association covered all the available coal, and consequently for some time little interest was taken in prospecting. The discoveries of Mr. French in 1865 opened a new district called the Westville or Bear Creek. This gave a great impetus to explorers, and large sums of money were spent on both sides of the river. The reports of Sir W. Logan and Mr. Hartley contain all that is known of the field, but the general public cannot be expected to derive much information from the exact and statistical form in which it is compiled.

On the west side of the East River the Acadia seam was proved for a distance of over two miles, and now supports three large collieries; two underlying seams were also found.

To the south a coal seam has been opened on, but not clearly connected with its right and left hand neighbours the Main and Acadia seams. Opposite New Glasgow the coal measures are found to dip south, and a large bed of coal has been proved.

The explorations on the east side of the river have opened a new district underlaid by three groups of seams, the Upper and Lower. In the latter are comprised the Albion and associated seams, while the former contains the Marsh and McBean Groups.

There can be no doubt as to the existence of the main seam beneath these, but its south outcrop has not yet been clearly defined, and its northern rise is covered by the strata containing the upper groups. The work of tracing the seams in this field is much increased by numerous faults and the depth of the drift covering. The courses of the central faults are more exactly defined by underground workings and exposures in water runs. A careful study of the ground between the Albion workings and the conglomerate furnishes a key to the position of the seams on the west side of the river, and a starting point for their detection in the eastern district. The first signs of a change in the northern dip of the main seam are found in the levels of the Foord pit, sunk 900 yards from the south boundary. At the bottom of the pit the pitch of the coal is 21°, but at the face of the north level 900 yards N. 44° W. from the pit bottom, the strike approaches north and the dip lessens to 11°. Still further to the west the dip workings of the Dalhousie pits were found to pitch at an angle of 28°—coming to the surface further signs of a change are observable. 50 chains north of the Dalhousie pit shales and sandstones are found dipping 19° N. 10° E. about 21 chains. North-west of this a seam of coal is found exposed in a brook dip 42° S. 10° E. The measures here are disturbed, and the axis of the synclinal is probably between the two points, as no further dip to the north has been observed. A sandstone quarry near the Gairlock road bridge over McCulloch's brook gives the dip 25° N. 40° E.; following the brook down, about ½ mile to the north of this, sandstones are observed with the dip 14° S. 25° E. Going east the first crops of the reverse pitch are found above the Nova Scotia Railway Bridge, lying at a heavy angle to the south with the strike turning to the north-east.

These dips establish a line of synclinal running nearly west from McCulloch's brook and agreeing with the fault observed by the geological survey on the New Glasgow side of the East River, 500 yds. above the railway bridge. The crop of the seam on the south edge of the Basin is regular and at an easy angle, while the measures exposed near the conglomerate and close to the supposed line of fault, pitch heavily to the south. This would indicate a sudden and violent upheaval of the northern half of the Basin acting at a period later than that which brought the southern crops to the surface, and the line of dislocation would be an upthrow going north. The turn of the measures to the north-east would carry the main seam under the town of New Glasgow, where it is overlaid by the seams of the upper groups.

The highest group on the east side of the river is the Marsh Brook, containing the Captain, Geo. McKay, and Millrace seams, with 158 feet of contained measures; their average thickness is four feet. This group forms an irregular basin the north crop of which rests on the great north fault, and the south crop is broken by faults bringing up lower measures. At the horizontal distance of 480 yards to the rise of their eastern crop is the McBean group. This series contains an eight foot seam and several others not yet fully examined; one 2ft. 6in. thick underlying about 80 feet is said to be of excellent quality. The following description may be more easily understood by the aid of a section drawn from McBean's slope on the 8ft. seam to the East River pit. The distance on this line between the crops of the Marsh group is 1¾ miles, they come to the surface at an easy angle and have been opened by slopes. The crop of the McBean has not been found to the rise of these seams, and in a short distance to the west the strata dip again to the north-west, and we are crossing higher measures till within 1500 yards of the East River pit, where the pitch reverses, and a short distance further on two openings have been made on seams dipping south-east and called the Lawson and Foster. The East River pit was sunk on an 8ft. seam also dipping east of south. A short distance to the rise is the Richardson seam, and continuing from the Pottery pit to the river bank we find the measures connected with the main seam and underlying to the south-east.

Our section gives us two basins, the eastern of which contains the Marsh group and the McBean dipping 33° N. 55° W. The other is underlaid by the Foster and Lawson seams believed to be equivalents of the Millrace and G. McKay, and gives the western crop of the McBean. As no explorations have yet proved the crop of the McBean on the anticlinal, its probable form is that of an undulation, and its crops are over four miles apart. The marked resemblance between the Richardson 2ft. 9in. and the 2ft. 6in. seam found 80 ft. beneath the McBean, adds to the probability that the 8 ft. seam of New Glasgow is identical with the McBean.

Turning again to the main seam we find it overlaid by 1130 feet of barren shales, succeeded by a small seam of coal, still ascending beds of sandstone alternate with the shale, and among them two or three small seams of coal, one of which before alluded to agrees in thickness with the Stewart seam believed to underlie the Richardson; should this be the case we can form an approximate idea of the thickness of the productive measures.

Lying unconformably against the southern crops of the Marsh and McBean seams are two groups known as the McLennan and McLean. The latter contains four beds of coal with an aggregate thickness of 25 feet. Little has been done to prove the position and thickness of the seams belonging to the former group, the two lower seams are each 4 feet thick and lie about 1650 feet above the McLean group, thus closely agreeing with the estimated section between the main seam and the supposed equivalent of the Stewart seam. Should these prove the equivalents of the Albion seams, we should find the crops of the Main seam beneath those of the McBean, and the continuity of the group established across the Basin.

There are 1130 feet of barren shale above the Main seam, and at least 400 between this point and the seam before mentioned. Crossing to the Stewart seam we find that its strike would carry it 500 yards to the rise of the East River seam, which, together with its pitch, would make the thickness of the intermediate strata 750 feet. We have thus the following table:

Main seam to Stewart seam	1530	feet.
E. River seam	750	"
Marsh Group	800	"
Contained in Marsh Group	170	"
Above Marsh Group	1740	"
	4990	feet.

Which would give the productive measures a thickness of at least 5000 feet.

The identity of the Widow McLean seams with those of the

Western district cannot be considered as settled, but the agreement in thickness of the overlying seams, and the slight difference in the estimated thickness of intervening strata, are strong evidences that the existence of the lower seams will be proved over all the Pictou Coal Fields.

Art. VIII. On the Meteorology of Caledonia Mines, Little Glace Bay, Cape Breton. By H. Poole, Esq., M. E.

(*Read March* 10, 1873.)

The accompanying record of meteorological phenomena observed at the Caledonia Mines during the year 1872, does not vary much from that of 1871. The barometrical and thermometrical readings are closely approximate, but the relative humidity, 82·46, (saturation being 100,) was greater than in the previous five years, which is to be accounted for by the largely increased amount of precipitation in rain and snow ; amounting to 74·955 ins., against a mean of 58·898 inches for the previous five years. The measured snow-fall was I73·35 inches, but the exact quantities of water contained in it could not be correctly measured apart from the rains ; as sudden changes in the temperature often prevented them from being recorded separately.

The number of days on which the wind blew from S. to W. was 151 ; from W. to N. 66 ; from N. to E. 100 ; and from E. to S. 49 ; shewing a larger increase of winds from S. to W., and N. to E. than in previous years. Forty-seven gales were observed, in which the Anemometer recorded velocities exceeding thirty-five miles an hour ; March, November, and December being the most stormy months ; while in September there was only one high wind to record on the 19th. continuing from 7 a. m. to 1 p. m., but which must have been much more severe seaward, as vessels passing on the 21st from the southward carried double reefed topsails.

On the 3rd. of January, ice made in the outer bay of Glace Bay ; and on the 7th drift ice was passing to the south. There was a gale on the 7th which sprung up in the afternoon from W. by S.

and veered to W. N.W. on the 8th. On the 12th a gale began in the forenoon from S. S. E. and veered to W. N. W. On the 18th a gale blew from S. W. to W. S. W.; and on the 25th it blew hard from W. by S. On the 7th Feby. the gale was W. N. W.; on the 12th and 13th, the wind blew upwards of 50 miles an hour from N. by W., and again on the 18th from N. by W. On the 28th the wind gauge only marked 15 miles per hour during the forenoon. March 10, a gale sprung up at 11 p. m. from S. S. E. and continued on 11, 12, and 13, veering to W. S. W., W. N. W., N. N. E. to N. E. by E.; on the 14th it backed to W. S. W., with a gentle breeze; but on the 15th it blew severely from S. E. (7 barns blown down at Baddeck,) on the 16th the gale continued and blowing from W. to W. by N., and backing to W. by S. on the 17th. On the 24th a gale commenced from E. by N., and backed to N. on the 25th. Two feet of snow fell in the woods, and the drifts were 12 feet high. Wild geese arrived at Glace Bay on the 30th.

On the 3rd and 4th April the wind blew a gale from W. N. W. to N.; on the 10th for a short time at night from S. W.; on the 17th, from 8 a. m. to 6 p. m. from N. by W., the wind gauge marked over 60 miles an hour; and on the night of the 27th it marked 30 miles an hour. On the 6th Blue Jay and Robin seen, and a Bluebird on the 8th; a Camberwell Beauty seen on the 23rd; a small Tiger butterfly on the 24th; Woodpecker on the 26th.

May 3rd and 4th, a gale from S. W., and the ice went out of Sydney Harbour. On the 28th a heavy rain at 4 a. m. with lightning and thunder, the wind veering from E. N. E. to W. S. W. Frogs croaking on the 2nd, Mayflowers in bloom on the 4th, Snipes and Kingfisher seen on 7th, and Mezereon in bloom. Herrings caught in Big Glace Bay on 8th, Bees seen on 9th, Swallows seen on 19th. White Violets blown on 24th, also Strawberries; Currants in leaf 25th; Coltsfoot, Willows and Alder catkins bloom on 26th; Gold thread (*Coptis trifolia*) on 28th; Snakes seen on 30th; Dandelions bloom 31st.

Only one gale in June with heavy rain on the 3rd from N. E. to N. W., and last of the drift ice passed. Mosquito hawk heard

TOTAL.
;8·090
;9·750
;0·490
;2·625
;3·535
'4·955
;1·576

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METEOROLOGICAL REGISTER, CALEDONIA MINE, LITTLE GLACE BAY, CAPE BRETON. 60 FT. ABOVE SEA. LAT. 46° 12′ N. LONG. 59° 57′ W.

1872.	Barometer. Corrected to 32°.	Barometer. Correc. for Vapor & 60 ft. above Sea.	Barometer. Highest Corrected.	th	Barometer. Lowest Corrected.	th	Thermometer. Mean	Thermometer. Mean Night.	Thermometer. Mean Day.	Coldest. Night.	th	Coldest. Day.	th	Hottest. Night.	th	Hottest. Day.	th	Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
January	29 6496	29·5936	30·520	4	28·819	24	20·22	14·58	25·87	–5	8	–1	7	39	6	50	5	·1160	83 5	2·946	606320	16·30
February.....	29·6762	29·6310	30·506	3	28·866	16	19·87	13·65	26·08	–2	2	14	1	32	16	41	22	·1052	81·6	2 672	638210	19·34
March	29·6382	29·5902	30·228	26	28·583	16	19·78	13·74	25·82	–0	21	14	12	28	29	43	11	·1080	84 7	2·702	867000	23·30
April....	29·6863	29·5705	30·214	30	28·993	2	34·59	29·20	39·98	19	6	32	18	38	11	52	8	·1758	80·6	4·465	653930	18·16
May	29·8306	29·6536	30·277	11	29·301	20	41·08	35·55	46·61	27	17	35	7	45	27	67	30	·2370	84·9	6·020	658510	17·70
June........	29·8613	29·5725	30 234	20	29·408	4	51·56	45·03	58·10	34	5	42	4	60	22	82	22	·3488	83·4	8·860	502150	13·95
July	29·7840	29·4017	30·136	9	29·471	23	61·00	53·80	68·20	39	3	58	2	65	11	84	1	·4423	76·9	9·234	516210	13 87
August......	29·9131	29·5030	30·177	3	29·443	31	60·30	54·80	65·80	44	3	58	4	65	9	86	10	·4701	84·7	11·940	514510	13·79
September ...	29·8900	29·5350	30·357	24	29·403	1	58·03	52·30	63·77	43	12	57	24	63	15	81	3	·4150	82·6	10·541	559980	15·55
October......	29·9493	29·7048	30·485	30	29·328	2	48·41	42·50	54·32	29	31	39	29	60	15	68	8	·3045	80·7	7·734	593960	15·96
November....	29·8241	29·6935	30·379	18	28 949	8	35·60	30·70	40·50	18	28	31	21	46	2	59	15	·1906	80·1	4·841	672530	18 68
December. ..	29·7550	29·6896	30·427	20	28·724	27	23·15	19·20	27·10	–2	25	–0	25	37	10	48	3	·1254	85·9	3·185	766380	20·60
Mean	29·7881	29.5948	....	..	....	..	39·47	33·75	45.18	...	..	..	..	....	.	..	..	·2532	82·46	6·261	629141 or150993	17·25 Miles.
Extreme ...	....	......	30.529	Jan. 4	28.583	Mar 16	....	......	.....	–5	Jan 8	–1	Jan. 7	65	Jul. 11	86	Aug 10	.....	..	......	7549690	......

1872.	Rain, includes Snow. Inches.	Rain. Days.	Snow. Inches.	Snow. Days.	Nights of Frost.	Degrees of Frost.	Below Zero.	Rimy Frost.	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows.	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	Wind. Turned. With Sun.	Wind. Turned. Against Sun.	True N. S. to W.	True N. W. to N.	True N. N. to E.	True N. E. to S.	Number of Gales.
January	5·815	17	18·50	14	28	546	2	1	1	3	4	.	2	5	5	1	..	2	2	18	10	1	2	7, 12, 18, 25
February.....	6·005	11	23·25	9	28	526	2	7	2	1	3	1	..	10	4	1	1	2	...	6	13	7	3	7, 12, 13, 18
March	8·155	14	67·85	13	30	556	1	5	..	..	1	..	..	4	8	2	..	3	5	6	9	12	4	10, 11, 12, 13, 15, 16, 17, 24, 25,
April....	4·565	16	11·25	9	28	97	..	5	2	2	9	..	..	5	3	2	..	2	2	12	6	9	3	3, 4, 10, 17, 28
May	7·455	21	......	2	9	17	..	2	1	..	15	2	1	1	8	..	..	4	2	9	5	13	4	3, 4, 28
June........	4·060	13	......	..	1	....	..	..	..	1	16	4	1	4	5	..	..	8	1	8	3	10	9	3
July	4·920	15	......	..	1	....	..	1	..	..	5	1	..	6	3	..	1	3	....	14	4	9	4	30, 31
August......	7·260	14	......	..	..	...	..	..	..	..	10	1	..	9	5	..	..	7	2	7	3	13	8	31
September ...	5·660	12	......	..	1	....	..	1	..	..	3	..	2	6	..	..	..	2	2	19	2	8	1	19
October......	6·925	15	.....	2	13	4	..	8	2	..	3	1	3	10	2	..	1	2	2	17	3	8	3	2, 8, 27
November....	7·405	19	5·00	6	21	102	..	5	1	..	2	1	1	8	3	1	2	2	2	16	4	7	3	1, 2, 7, 8, 13, 26, 30
December. ..	5·730	18	47·50	15	28	411	2	..	2	..	2	1	..	2	6	..	..	3	1	19	4	3	5	10, 13, 19, 22, 24, 25, 28
Mean	8·246	15	......	..	..	....	..	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	..	....
Extreme ...	74·955	185	173·35	70	188	2259	7	35	12	6	73	12	10	69	52	7	5	46	21	151	66	100	49	47

COMPARED WITH THE ABOVE.

Year.	Corrected to 32°.	Correc. for Vapor & 60 ft. above Sea.	Highest Corrected.	th	Lowest Corrected.	th	Mean	Mean Night.	Mean Day.	Coldest Night.	th	Coldest Day.	th	Hottest Night.	th	Hottest Day.	th	Force of Vapour in inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
1867. Mean	29·8524	29 6704	......	Feb	......	Sep	40.06	34·17	45·95	..	Jan	....	Dec	...	Aug	...	Aug	·2438	72·87	6·194	643534	17·6
Extreme	....	....	30·768	11	28·676	30	...	....	...	–10	31	1	31	67	25	85	9	....	....	......	7722414 or154448	.... Miles
1868. Mean	29·8854	29·6924	......	Mar	....	Feb	39·29	33·64	44·84	....	Feb	....	Feb	....	July	....	July	·2454	74·30	6·233	675908	18·5
Extreme	... .	....	30·611	6	28·899	6	....	....	....	–13	4	4	22	66	2	89	5	....	....	......	8110903 or162218	.... Miles
1869. Mean	29·8413	29·6325	......	Dec	......	Feb	40·80	34·44	47·17	....	Jan	...	Jan	....	Sept	....	July	·2696	68·10	6·849	612927	16·8
Extreme	....	... ...	30·590	11	28·886	4	....	.....	....	–9	23	1	23	69	9	86	29	....	......	....	7355130 or147102	... Miles
1870. Meen	29·8433	29·6251	......	Jan	...	Feb	41·57	35·90	47·50	....	Feb	....	Feb	....	July	...	July	·2691	74·00	6·787	634806	17·4
Extreme	....	....	30·560	1	28·460	1	...	.....	....	–2·5	4	6	4	69	9	89·5	24	....	......	....	7617670 or152353	.... Miles
1871. Mean	92·7915	29.5992	......	Dec	......	Feb	39·84	34 23	45·46	....	Jan	....	Jan	..	Sept	...	Aug	·2523	78·25	6·402	629860	17·34
Extreme	....	....	30·719	23	28·771	4	....	....	....	–8	24	–3	23	66	6	83·5	4	....	......	....	7558320 or151166	.... Miles

Year.	Rain Inches.	Rain Days.	Snow Inches.	Snow Days.	Nights of Frost.	Degrees of Frost.	Below Zero.	Rimy Frost.	Hail.	Silver Thaw.	Fogs.	Light'g & Thun.	Rainbows.	Auroras.	Halo rd Sun.	Halo rd Moon.	Corona.	With Sun.	Against Sun.	S. to W.	W. to N.	N. to E.	E. to S.	Number of Gales.
1867. Mean	4·841	12	.....	..	..	....	..	..	..	..	..	..	..	..	..	..	..	...	....	..	..	..	..	
Extreme	58·090	147	125·0	52	172	2171	7	23	5	5	25	9	6	26	16	3	0	36	17	122	114	54	75	
1868. Mean	4·975	12·5	.. ...	..	..	....	..	..	..	..	..	..	..	..	..	..	..	..	....	..	..	..	..	
Extreme	59·750	152	94·5	65	193	2486	15	18	6	3	28	12	6	35	23	7	2	35	5	129	107	76	54	
1869. Mean	5·041	11·7	.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	....	.	..	..	..	
Extreme	60·490	140	91·75	48	186	1794	6	37	8	6	41	6	7	39	27	6	3	36	9	124	104	81	56	
1870. Meen	5·219	13·3	.....	..	..	...	..	..	..	..	..	..	..	..	..	..	..	....	...	..	..	..	..	
Extreme	62·625	169	102·0	56	183	1499	3	47	11	8	61	17	12	102	34	12	4	38	7	123	99	85	58	
1871. Mean	4·461	15·0	.....	..	..	.. .	..	..	..	..	..	..	..	..	..	..	..	...	....	..	..	..	..	
Extreme	53·535	185	109·0	74	200	2043	8	57	4	10	71	14	15	67	57	15	8	43	23	133	100	82	50	

TABLE No. 2. RAIN–FALL COMPARED.

Year.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Septr.	Octr.	Novr.	Decr.	Total.
1867........	5·915	5·395	5·965	5·085	5·370	2 010	3·080	2·560	11·265	2 920	4·780	5·745	58·090
1868.......	4·665	5·545	3·945	5·320	3·145	6 057	2 122	3·428	6·956	7·745	5 700	5·120	59·750
1869........	3·610	5·820	6·005	4·420	7·400	3·300	6·400	2·728	2·870	7·220	5·065	5·655	60·490
1870........	6·550	7·605	8·980	3·870	1·705	2·475	2·120	3·316	6·575	6·195	9·065	9·175	62·625
1871........	4 840	2 630	6·245	7·830	2·900	1·560	4·205	4·595	4 820	4·325	4·150	5·435	53·535
1872........	5·815	6·005	8 155	4·565	7·455	4·060	4·920	7·260	5·660	6 925	7·405	6·730	74·955
Mean	5·232	5·500	5·716	5·182	4·662	3·243	3·808	3·980	6·376	5·888	6·027	6·310	61·576
1867........	10	5	11	7	8	1	4	2	12	3	6	9	
1868........	5	8	4	7	2	10	1	3	11	12	9	6	
1869........	4	8	9	5	12	3	10	1	2	11	6	7	
1870...	8	10	6	5	1	3	2	4	9	7	11	12	
1871.... ...	9	2	11	12	3	1	5	7	8	6	4	10	
1872........	5	6	12	2	11	1	3	9	4	8	10	7	
Mean	6	7	8	5	4	1	2	3	12	9	10	11	

In the table above; No. 1 shows the month in which the least quantity of rain has fallen, and so on, up to 12 which marks the greatest precipitation. June being the dryest month, and September the wettest during a period of six years.

HENRY POOLE,
Caledonia Mine, Cape Breton.

on 12th. Clintonia borealis, and Cornus Canadensis in bloom on 15th, and first Salmon caught in Big Glace Bay. Wasp seen on 18th, Swallow-tailed Butterfly on the 21st; Caterpillars attack Gooseberries on 24th; Apples, Crabs, and Plums bloom on 25th.

In July a gale lasted from 7 a. m. on the 30th to 5 p. m. on 31st, blowing from S. to W. S. W. accompanied by rain. Ripe Strawberries gathered on 6th; Fireflies seen on 7th; three Curlews seen on 21st.

August 31st, a gale from E. with heavy rain which measured 3·745 ins. in 25 hours accompanied by thunder and lightning. Many shooting stars on nights of 9th and 10th passing from E. to W. The gale previously mentioned on the 19th Septr. was preceded by a rainstorm of 3.380 ins. from N.E. in 24 hours. Maple and Dogwood leaves turned red on 6th; Wild Geese seen on 18th.

October 2nd a gale from S. S. E. with a double rainbow 3 p. m. On the night of the 8th from S.; on the night of 28th from N. W. by W. Snow fell on 21st at Lingan. On 30th saw a butterfly.

Novr. 1st and 2nd, gale from E. A number of Turs (little auks) picked up dead on the 4th on the shore; on 7th and 8th a gale from S.E. Wild strawberries in bloom on 9th. Gale on 13th from S. to S. W. from 8 a. m. to 3 p. m. On the 26th it blew from the West a gale from 8 a. m. to 2 p. m., succeeded by a calm night; and on the 30th a gale from the S. E. was accompanied by lightning and thunder from 1. to 7 a. m.

On December 10th a gale blew from S. W., the greatest force marked being from 1 to 2 p. m. On the 13th a heavier and longer gale prevailed from E. N. E., blowing hardest during the night. On the 19th it blew a gale from W. N. W. in the afternoon. On the 22nd during the night from E. by S. On the 23rd horses were travelling on Big Glace Bay Lake. On the 24th a severe gale with snow began at 3 a. m. from W. by S,. and continued all that day and the next (Christmas day) from the same quarter until 5. p. m. when it moderated, and blew from the W. at 9 p. m., when the thermometer marked 13 degrees, it having stood at zero all through the day. On the 28th it blew hard from the W. S. W. during the afternoon, succeeded by a cold night, when the register thermometer marked one below zero.

Of these 47 recorded gales 17 blew between the South and West; eight between South and East; eleven between West and North; and eleven between East and North.

The greatest velocity of wind registered in 24 hours during the month of January was 882·8 miles on the 12th.

February	1061·4	"	"	7th.
March	1346·8	"	"	25th.
April	1443·8	"	"	17th.
May	966·2	"	"	3rd.
June	764·4	"	"	3rd.
July	837·2	"	"	30th.
August	633·2	"	"	27th.
Septr.	667·2	"	"	19th.
Octr.	870·0	"	"	27th.
Novr.	1112·0	"	"	7th.
Decr.	1343·4	"	"	13th.

Art. IX.—The Affinity of Races. By Wm. Gossip.

(Read April 14, 1873.)

The paper I am about to read does not recommend itself by any new scientific discovery. It is ethnological in its character, but speculative, hypothetical and discursive. It may serve to vary the routine of our ordinary meetings, but I fear will be of little value except perhaps as it may be an incentive to pursue the subject. It presumes an affinity of races in the Eastern and Western hemispheres, based upon a similarity of names, of etymologies and customs. I can adduce no positive evidence to prove the connection; and there are forcible reasons in the wide expanse of ocean between the Continents at the present day, against the probability of inter-communication at any previous period of human history. Still, if we believe in the unity of mankind, the peopling of America remains to be accounted for on hypotheses or theory, either of disruption or derivation, or both, in the absence of complete evidence; and therefore I trust you will bear with me, although to say the least the subject is of a most unpromising and impracticable nature.

My attention was directed to the affinity or relationship of the human family in the Eastern and Western Hemispheres, by the following circumstance. About two years ago there appeared in the *Church Chronicle*, published in this city, a well written article, comparing a passage in Herodotus, on the customs of the *Carian* women of Asia Minor, with what is recorded of the customs of the *Carib* women of the Antilles at the time of the modern discovery of the latter by Columbus. The similarity is somewhat remarkable. The author of the article suggested that it might help to account for the peopling of some of those islands, or of the central portions of the continent beyond. But at the period of which Herodotus writes, there could have been no communication between the Eastern and Western continents, and nothing can be gathered therefrom to show affinity in any way. I believe, however, and it is to this I would direct attention, that there may have been affinity in the remoter past, of which these mutual customs were a relic.

The passage referred to from Herodotus, is as follows: "Those of them who set out from the Prytaneum of Athens, and who deem themselves the most noble of the Ionians, brought no wives with them when they came to settle in this country, but seized a number of Carian women after they had killed their men, and on account of this massacre, these women established a law, and imposed on themselves an oath, and transmitted it to their daughters, that they would never eat with their husbands, nor ever call them by the name of husband, because they had killed their fathers, their husbands and their children, and then after so doing had forced them to become their wives. This was done at Miletus."

When Herodotus relates any event or circumstance falling under his own observation, his veracity is indisputable; but what he relates from other sources is not always to be depended on. It may be valuable as a reflex of the belief or opinions of his time, but remains to be judged in the light of superior modern knowledge and civilization. The story therefore of the Carian women, with ample foundation in fact, has been mixed up with the inroad of the

Ionians, who slew their husbands. The truth seems to be, that the Carians at that epoch being still a barbarous people, the women were treated just as are the women of all such savage people—as the Indians of North America—as the Caribs treated their women. They were slaves to the men, administered to their wants, their comforts and their pleasures, but were, if I may so speak, a separate institution, with no community of interests or feelings except as the stronger sex permitted. Thus we may readily believe that the customs of the Carian women did not originate when they were captured by the Ionians, or that the latter were responsible for them. They merely followed those which had grown up with them, and to which they had become inured. In this respect they were on an exact parallel with their uncivilized sisters in both hemispheres, and were in affinity with them. The Carib women were socially degraded when the Spaniards came among them, and satisfied with their inferior position. Improvement, so far as they were concerned, depended entirely upon the civilizing influences of settled life, to which their nature had not attained. They were thus even far behind the inhabitants of the larger Antilles. Historians describe the Caribs as an intelligent people, and probably they were not much inferior to the Ionians at the time of their migrations.

Lafiteu and other historians describe the Caribs as a distinct race from the Indians who inhabited the larger Antilles—Hispaniola, Cuba, Jamaica and Trinidad. These last were evidently pre-occupants of the Islands. They are represented as of common origin, speaking the same language, mild in disposition and comparatively cultivated, possessing the same institutions, and practising similar superstitions. The Caribs who had conquered the smaller windward islands, frequently made descents upon the others, and their depredations were much dreaded. They were enterprising and energetic, extremely jealous of their independence, ferocious, cruel, and cannibals, devouring the bodies of their enemies. They knew nothing of their origin, and had no traditions that pointed to it. They delighted in war, and the conquest of all the neighbouring islands, peopled by a race effeminate by comparison, would probably have been only a work of time, had they not been interrupted in their designs by the Spanish discovery. The radical difference between the language of the Caribs, and that spoken by the natives of Hispaniola and the other islands, is of itself convincing that they were a distinct people. Some authors have supposed that they came at first from Florida—that a colony of the Appalachian race having been driven from the Continent, arrived at the Windward Islands, and exterminating the ancient male inhabitants, took possession of their lands and their women. But besides other objections to this, it is sufficiently known that there existed numerous and powerful tribes of Charaibes in the southern peninsula, extending from the river Orinoco to Essequebe, and throughout the whole province of Surinam even to Brazil. This gives some colour to an idea of their derivation from the Eastern continent. It is admitted that their own traditions referred constantly to Guiana, where they were always at war with the Arrawak tribes, their hereditary enemies. It does not appear that they entertained the most remote idea of a northern ancestry.

Their customs were peculiar. Polygamy prevailed among them. The climate made clothing unnecessary, and both sexes went stark naked, without any sense of shame or indecency. The women were mere drudges; they did not eat with the men nor were admitted to an equality with them; they ground the maize, prepared cassava, and gathered in the cotton. Both men and women had shining black hair, the women's being finer than that of the men. They dressed it with daily care, the men in particular decorating their heads with feathers of divers colours. Both had a fondness for red paint, a peculiarity of savages all over the American continent, and every where; and they covered their faces and bodies with arnotto so extravagantly, that their natural complexion which was nearly that of a Spanish olive, was not easily distinguished under the surface of crimson. Besides this, the men disfigured their cheeks with deep incisions and hideous scars, which they stained with black, and they painted white and black circles round their eyes. Some of them perforated the cartilage that divides the nostrils, and inserted the bone of some fish, a parrot's feather, or a fragment of tortoise shell; they strung together the teeth of their enemies slain in battle, and wore them as trophies on their arms and legs; they resided in villages, in cabins constructed like the Indian wigwam, except that the covering was palm leaves instead of birch bark. As to their religion, it is reported that they had not even a name for the Deity, although they seemed to entertain an indistinct sense of a superior wise and invisible Being, of absolute and irresistible power, and admitted the agency of subordinate divinities; they even supposed that each individual had his peculiar protector or tutelar deity. They had some notion also of practical worship, for besides their funeral ceremonies, which embodied observances common in both hemispheres, it was their custom to erect in every cabin a rustic altar composed of banana leaves and rushes, whereon they occasionally placed the earliest of their fruits and the choicest of their viands, as humble offerings to avert the wrath of incensed Omnipotence.

Thus far but few analogies will be detected that will refer the Caribs to a Mediterranean origin. Indeed the description would answer for any of the Indian tribes on and to the north of the Mississippi, especially those of them who were not sun worshippers. We might go a step further and conjecture with some degree of plausibility, that they were an offshoot, either of the Algonquin, the parent stock of our Micmacs, or of the Iroquois races. The former was the most widely spread of all the northern aboriginal races, and was well known as far south as the mouth of the Mississippi, which is an Algonquin word; while the latter had all the characteristics of the Caribs, in their love of independence, their warlike habits, their aptitude for conquest, and even their cruelty. But if it were so the connection must have been far remote, and all remembrance of that and their separation had been lost. They had no knowledge of each other, nor is it recorded that there was any similarity in their languages.

The somewhat cautiously hazarded hypothesis of the writer in the *Church Chronicle*, that the Caribs came from the Eastern Continent, is not without supporters, although their theories are not based upon the same facts. Edwards, the substance of whose history respecting them, I have largely availed myself of, " without attempting to controvert the position to which recent discoveries seem indeed to have given a full confirmation, namely, that the

Asiatic Continent first furnished inhabitants to the contiguous north western parts of America, conceives the Caribs to have been *a distinct* race, widely differing from all the nations of the new hemisphere," and is inclined to adopt the opinion of Hornius and other writers, who ascribe to them an oriental ancestry from across the Atlantic. I will quote as succinctly as possible the reasoning by which this writer convinces himself of the truth of his position :— "If we reflect" he says "on the limited extent of navigation before the discovery of the compass, the prevailing direction of the winds between the tropics, and various other obstructions, we may I think very confidently determine *that no vessel ever returned from any part of America before that of Columbus*—a conclusion however, that by no means warrants us in pronouncing that no vessel ever arrived from the ancient Continent, either by accident or design, anterior to that period." The probability of such arrival, he evidences as follows :—

"There is no circumstance in history better attested, than that frequent voyages from the Mediterranean along the African coast, in the Atlantic Ocean, were made both by the Phœnicians and Egyptians many hundred years before the christian era.

"We know from indisputable authority that the Phœnicians discovered the Azores, and visited even our own island (Britain) before the Trojan War.

"Their successors the Carthaginians were not less distinguished for the spirit of naval enterprise, as we may conclude from the celebrated expedition of Hanno, who about 250 years before the birth of our Saviour, sailed along the African coast until he came within five degrees of the Line.

"It was the Carthaginians who first discovered the Canary Islands, and it appears from the testimony of Pliny, that they found in those islands, the ruins of great buildings, (*Vestigia Edificiorum*,) a proof that they had been well inhabited in periods of which history is silent.

"Not less clear historical evidence are the accounts of the Phœnician navigation down the Arabian Gulf or Red Sea to distant parts of Asia and Africa, in ages still more remote. In the voyages undertaken by King Solomon, he employed the ships and mariners of that adventurous and commercial people. With their assistance he fitted out fleets from Ezion-geber, a port of the Red Sea. Of these ships some were bound for the western coast of the great Indian continent; others there is reason to believe turned towards Africa, passed the southern promontory, and returned home by the Mediterranean to the port of Joppa."

He thus considers it clearly proven "that the navigation of the Atlantic Ocean along the coast of Africa, both from the north and south and even at a considerable distance from land, was well understood, and frequent in very remote ages; and that if we inquire into the nature of the winds and currents on the African coast, and reflect on the various casualties to which ships at sea are liable, even in the most favorable season of the year, we must admit that it not only probably happened in some of those ancient expeditions, but even that *it was scarce possible not to happen*, that vessels would be driven by sudden gusts, or carried by adverse currents within the verge of the trade winds; in which case if they happened to lose their masts, they must necessarily run before the wind towards Brazil or the West Indies."

He quotes two remarkable instances of this nature which have happened in modern times—the first related by Capt. Glass, in his history of the Canary Islands, who observes—"that a small bark bound from Lancerota to Teneriffe, was thus forced out of her course, and obliged to run before the wind until she came within two days sail of the coast of Caraccas, where she fortunately met with an English cruiser which relieved her distress, and directed her to the port of La Guaria. The other is told by Gumill (a Spanish historian) which happened Dec. 1731, while he was at the town of St. Joseph, in Trinidad, when a small vessel from Teneriffe, with six seamen, was driven into that island by stress of weather, the crew reduced to the last extremity. To these instances may be added the discovery by Columbus himself, of the stern post of a vessel lying on the shore at Guadaloupe. Martyr also mentions that at a place called Quarequa, in the Gulf of Darien, Vasco Nunez met with *a colony of negroes*, who from the smallness of their number it was supposed had not been long arrived upon that coast." Many other instances might be adduced, of much more modern date, of accidental arrivals at the Western Continent.

Taken as sufficient evidence that the ancient Egyptians, Phœnicians, Jews, and probably a good sprinkling of the people of Asia Minor, including the Greeks, became acquainted either as mariners or merchants, with the western coast of Africa, and even with the Azores and Canaries, yet these accounts go no further, and all else is supposition. There is nothing on record except the apochryphal Ophir, (which some have assumed to be a part of Central America,) from whence Solomon imported gold and silver and ivory, apes and peacocks, to suggest a probability that his or any other navy of the period or previously, either by accident or design, touched at this continent. Yet it is difficult to account for the civilization that prevailed in Central America, so analogous to the ancient civilization of the Eastern hemisphere, except that accident may have thrown some of those ships on the coast, from which they would find it impossible to return whence they came, and where their crews remained to communicate so much of the arts of civilization as they themselves were acquainted with, and thus to form the basis of, or to give an impulse to that which existed at the time of the modern discovery of the continent.

The Caribs had many customs and observances which seemed to connect them with such an ancestry, without possessing that degree of civilization which might be expected to accompany it. Even their language has been quoted and compared with the Phœnician and Hebrew, in proof of their oriental derivation. None of these, however, are conclusive tests. They do indeed carry them back to an antiquity far more remote than those nations, and may be adduced in favour of their being derived from one family, in which respect they were only on an equal footing with the whole American race. The historian Edwards, to whose work I have frequently alluded, with reference to their language, says, "It is scarcely possible to doubt that the following words used by the Charaibes, had their origin in the Old Hemisphere. [Examples on the black board, but cannot be quoted here for want of oriental type—see Edwards' History.] It may also be observed, that Dawson in his Acadian Geology, a chapter of which is devoted to prehistoric man, claims a similar affinity for the Micmac language. I have placed the examples he has given in juxta-position with those of Edwards, [on the black board.]

Albert Gallatin, an American Secretary of State, who bestowed much attention on the Indians, in an analysis of the various languages of the northern half of the American Continent, has shown that they are all similar in construction, and making allowance for the total separation from each other of many of the tribes, that they are derived from one original language, which may be taken to be the most ancient on the face of the earth.

Father Joseph Gumilla, in his account of the nations bordering on the Orinoco, relates "that the Charaibes of the continent punish their women caught in adultery like the ancient Israelites, by stoning them to death before an assembly of the people." There is no trace that such a custom existed amongst the insular Caribs who, before they had any intercourse with Christians had no established punishment for adultery, which was unknown as a crime. As such a fact is not described by any other author, it may not be well founded. It is supposed to have been brought forward to support an hypothesis which has always been received with more or less favour—that the aborigines were descended from the Jews. But were the relation worthy of all credence, while it would be a remarkable coincidence, it would not follow that the punishment was derived from Moses' Law, which doubtless in this as in many other instances, was a counterpart of that instituted at a much earlier period in the history of mankind, and again rendered necessary under the circumstances in which the Israelites were placed.*

They had other customs, observances and ceremonies, indicative of high antiquity, which appear to have been possessed by the most ancient nations bordering the Mediterranean. They are described as having voracious appetites, and yet to have rejected many of the best bounties of nature. Of some animals they held the flesh in abhorrence: these were the peccary or Mexican hog, an animal very much resembling our swine, the manati or sea cow, and the turtle. Labat observes that they scrupled likewise to eat the eel, which the rivers in several of the islands supply in great plenty. The confor-

*The Mexicans punished the crime of adultery by stoning to death: but their code of morality was much stricter than that of the Caribs.

mity of these prejudices to those of the Egyptians, long before the exodus of the Jews, and to those of the Jews in every period of their national history, is remarkable. Yet one fact alone is sufficient to prove that there could be no affinity except such as must have subsisted in the earliest ages of mankind. There can be little doubt from what is stated, that they made a distinction between clean and unclean animals, which must have been impressed long previous to the age of Noah. But the Caribs did not practice circumcision, which was pretty general amongst the early Egyptians, and is an imperative obligation amongst the Jews to the present day, and would have been observed also by the Caribs had there been any affinity with those nations. This omission attests that they were not indebted to either for their origin, or to any accidental influences by which the peculiar rites of Jewish civilization could operate to change their mode of life.

Another curious custom proving their high antiquity, and bearing upon the question of their affinity, which appears very extraordinary, but is well authenticated, is related of them. On the birth of his firstborn the father took to his bed with the baby, and fasted with a strictness that often endangered life. On the birth of every male child he was sprinkled with some drops of his father's blood. Lafiteu observing that this custom was also practised by the Tybarenians of Asia, and the Iberians or ancient inhabitants of Spain, and is still in use amongst the people of Japan, not only urged the circumstance as a proof among others that the new world was peopled from the old, but pretends to discover in it some traces of the doctrine of original sin; he supposes that the severe penance thus voluntarily submitted to by the father, was at first instituted in the pious view of protecting his issue from the contagion of hereditary guilt; averting the wrath of offended Omnipotence at the crime of our first parents, and expiating their guilt by his sufferings. Strange then as this custom was, and practised among other American tribes, of which several instances might be adduced, it was likewise prevalent among some of the most ancient races of the Eastern hemisphere. It is strong evidence of affinity with them, although so widely separated; but it does not imply that the new world was peopled from the old. The traces of the doctrine of original sin, which Lafiteu finds in a custom thus widely dispersed, but of which the meaning seems to have been lost, is however of some importance in determining the unity of mankind, and the subject in this connection deserves more attention than hitherto it seems has been bestowed upon it.

Their mode of burying the dead affords another important instance of the primordial antiquity of the Caribs, places them on a parellel in this respect with other American tribes, and without furnishing any particular proof of derivation, establishes an affinity with the most ancient races of the Eastern continent; and further confirms belief in the unity of mankind, and their descent from Adam and Eve. The most ancient Carians interred their dead in the same manner, and it is probable with similar ceremonies.* The investigations of archæologists in Europe, have resulted in a classification of modes of interment, which determines the comparative although not the remotest antiquity of offshoots of the primitive stock farthest removed from centres of civilization; and then the gradual introduction among them of progressive arts and science. The stone age, the bronze age, and the iron age, represent as well as customs of burial, phases of increasing knowledge, from the rudest condition of humanity, when all remembrance and all tradition of previous civilization, even in degree had been lost, to periods when improvement had been introduced from abroad, and in process of time matured and perfected. In the most abject condition there appears no connection either with an Egyptian, Assyrian, or Phœnician origin, or with any previous era. Only a few customs remain to determine the original unity. Yet as far back as we can obtain any knowledge of the rudest tribes, and beyond all knowledge of them, we find in other regions, highly civilized peoples, cultivating art and science, and manifesting a progress, the origin of which can be traced by the Biblical record, to be coeval with man's creation, and quite apparent amongst the first families of mankind. There ought to be no doubt then, from whence the savage tribes derived their progressive improvement. This wisdom from on High, and the capacity to improve it, has never

*Thucydides—Delos.

been lost to the world. It has frequently changed its base, but it has always advanced and spread itself abroad. We may say that it was almost contemporaneous in Egypt and Assyria, in India and Phœnicia, in all of which it may have been introduced (you will excuse the hypothesis which has taken possession of my mind and to which I shall again allude) by the sons of Noah and their progeny. They preserved their genealogy, were perfect in their generations, and transmitted the high cultivation of a race that peopled some particular region beyond the confines of Paradise, wherever that may have been, down to the time of the Flood, to all the countries to which they spread after that event. Some of their descendants having at length arrived at the Mediterranean, they found a land suitable for settlement, and a people with whom they mingled, whose derivation, customs, and dialects may have been similar to those of the American tribes, but who were perhaps better fitted to accept the improvements that were tendered to them by this regenerating race.

It is difficult at the present day to ascertain whether or not the Mediterranean was affected by the Noachian deluge. An obscure tradition or myth among the Greeks* points to such an event. The most ancient Egyptian monuments are quite oblivious of that catastrophe. The record however, of customs which may be considered ante-diluvian are numerous. They are found amongst the Carians as amongst the Caribs, in their tombs. Far beyond the age of bronze, when the people on the shores of Asia Minor knew of no other implements than those they manufactured of stone, they buried their dead, as the Caribs buried theirs, in a contracted posture, with their knees to the chin, a practice that was first modified and then changed, when bronze and iron came into use. Wherever mankind had wandered by successive removals far from the primitive home, had realized that the earth bare unto them only thorns and thistles, and were led to a dependence on the wild beasts and fishes for subsistence, their normal intelligence being entirely superseded by animal instinct, this custom seems never to have been forgotten. All throughout Europe it prevailed, and what is remarkable as proving

* The deluge of Ogyges.

an affinity and identity of race, in most instances the skulls of the remote stone age men, both in Europe and America, bear to each other a strong resemblance. They were dolichocephalic, or long headed. In some instances, more frequent however in the western than in the eastern hemisphere, flattened or distorted in infancy by compression. If there be any here who desire to become acquainted with prehistoric man, I would refer them to a recent work by Sir John Lubbock, entitled "Prehistoric Times." The conclusion drawn from customs of burial, is thus stated:—"There can be no doubt that in the Neolithic stone age (*i. e.* the age which showed an improvement in the make of stone implements) it was usual to bury the corpse in a sitting or contracted posture; and in short it appears probable, although far from being satisfactorily established, that in Western Europe this attitude is characteristic of the stone age, cremation of that of bronze, while those cases in which the skeleton was extended may be referred with little hesitation to the iron age." It only remains to say that the Caribs of the West Indies, (and all the northern tribes,) had got no further than the Neolithic age at the arrival of Columbus; although the bronze age was at their door, and would soon have been upon them in the extension of Mexican civilization.

I might adduce many other customs and ceremonies of the Caribs, which would imply a connection at some remote period, and a common origin, with the most ancient races of the Eastern hemisphere; but time will not allow, even if it were not a trespass on your patience. I may mention, however, in conclusion of these observations on a most interesting people, now almost entirely extinct, that they practised to a certain extent the art of agriculture. Strange to say they knew how to prepare cassava, by neutralizing the poisonous properties of the manioc from which it is made, by a process similar to that employed on the coast of Africa. They also cultivated the maize, which is an African cereal, although apparently indigenous in America. Strangest of all was their habit of chewing the betel, preparing it with calcined shells, after the manner of the natives of the East Indies. By what mysterious means they had acquired this proportion of knowledge, we shall never be able to ascertain; but if they did not possess it from the beginning, in common with the ancient nations of the earth, we may be allowed to conjecture with others, that it may have been communicated by some accidental arrival on their shores from the Eastern Continent; or it may have been received from the people of the adjacent islands, who were a distinct race, and of whom nothing is more certain than that they preceded the Caribs in their occupation of those beautiful spots of the earth.

PART II.

THE affinity of the most ancient races in the Eastern and Western Hemispheres is much easier of proof *at the present day*, than are the causes that led to their total separation. Yet nothing can be more clear, affinity being granted, than that a separation at some early period of the history of mankind, attended with extraordinary circumstances, must have occurred to account for their perfect isolation and the total oblivion of each other that had so long existed. Nothing but a tremendous cataclysm, dividing the lands in the midst and interposing an ocean between them, can satisfy this requirement. Of such an event there is no positive record, or at least the record does not fully warrant the inference. I shall again advert more particularly to this branch of the subject; but in the meantime desire to direct your attention to the Mediterranean Sea, the countries on the borders of which appear to have been specially prepared for the reception and civilization of mankind.

There would seem to have been much greater facilities for maritime peoples of ancient times to pass into the Mediterranean from India, Africa and Europe, than are afforded naturally at the present day. "Ancient authors entertained strong opinions on the subject. Aristotle held that the Mediterranean had at one time covered a large part of Africa and Egypt, and had extended inland as far as the temple of Jupiter Ammon. This doctrine was maintained also by Xanthus the Lydian, Strabo and Eratosthenes. The ancients appear to have been led to this conclusion, by observing in various parts of Africa and Egypt manifest traces and indications of the sea. They found there shells, pebbles evidently rounded or worn smooth by the action of water, incrustations of salt, and many salt lakes. Some of these appearances were particularly frequent on the route through the desert to the temple of Ammon.

"The ancient writers maintained, that the temple and oracle of Ammon never would have become so famous, if the only approach to them had always been over vast and dangerous deserts. They insisted that the Oases had all originally been islands in the earlier and more widely extended Mediterranean. In this remote period, according to them, there existed as yet no communication between the Pontus Euxinus and Mediterranean Sea, nor between the latter and the Atlantic. The isthmus connecting Arabia with Egypt was under water, and Eratosthenes believed that Menelaus had sailed over this narrow passage, which is now the Isthmus of Suez. When the waters of the Euxine forced a passage into the Mediterranean, the great influx of water opened another outlet for itself through what were called by the ancients the Pillars of Hercules—Spain and Africa having been previously joined. In this tremendous convulsion the ancient land of Lectonia is thought to have been inundated and to have sunk in the sea, leaving merely the islands of the Archipelago its mountain tops, to attest its former existence. According to Diodorus Siculus, the inhabitants of Samothrace had a tradition that a great part of their island, as well as of Asia, was ravaged and laid under water by this inundation, and that in passing near their island fragments of temples were frequently rescued from the waves."

If the belief of Eratosthenes previously quoted, were realized, a passage would have been open to the Indian and Atlantic Oceans. "The Ethiopians pretended to have planted the first colonies in Egypt, soon after that country had emerged from the waters of the Mediterranean, by which it was traditionally reported to have been covered. Tradition also refers to a northern passage to the ocean. The belief for a long time prevailed that there was a communication between the Palus Maeotis (Sea of Azof) and the Oceanus or earth-encompassing stream. The Argonauts were thought to have passed up the Phasis into the Palus Maeotis, thence up the Tanais, from the head of which they transported the Argo over land to a river that fell into the main ocean, and thence directing their course to the west to have come to the British Isles and the Atlantic, and to have reached at last the Columns of Hercules." These traditions which have very little historic value, may however point to a time when the Mediterranean Sea may have had several outlets, and was therefore more open to foreign arrivals of mankind than after it had settled to its present outline and configuration. The only natural passage now to the Atlantic, is by the Pillars of Hercules (Straits of Gibraltar).

At the close of these disturbances, or during their continuance, we may safely conclude that the habitable coast of Asia Minor was occupied by wanderers of the primitive stock, who although more remote in time, were probably as rude and uncultivated as the people of Northern Europe whose remains in our day are of so much interest to the archæologist. The affinity of these people with the American race is exceedingly probable, but there appears to have been a remarkable distinction between them. The western race had no subsequent communication with the civilization from which they had wandered, or, if the ancient remains on this continent depend upon it, it was confined to a few centres where it was afterwards overlaid or destroyed. The last condition of things may have happened in the era of the mound builders; and its destruction by the inroads of barbarian tribes of the same race. Finally it may have revived in Mexico and Peru and Central America, where it took thousands of years to recover itself, and had but recently begun as it were to assert its strength, when the modern discovery of the country again doomed it to destruction. The Mediterranean people, on the contrary, had the elements of civilization introduced among them at an early age. The Pelasgians who possessed it imperfectly first came among this primitive race, at what time cannot now be determined. Their origin also is lost in mythological obscurity.

Inachus (Enoch or Anak great and powerful) son of Oceanus and Tethys, significant of his being reared on the ocean, is said to have been the first king of Argos. Phoroneus the Pelasgian, son of Inachus and the ocean nymph Melia, is significantly styled the first man—he gave the aborigines fire and social institutions. Car, his son (or the son of Manes, or Man, the derivation is not clear) is claimed by the Carians as the patriarch of their race. Mysis and Lydus, are brothers of Car, and eponyms or patriarchs of the Lydians and Mysians. Another descendant of Phoroneus, Pelasgus, is said to have given his name to the Pelasgians. These mythical genealogies, which are not to be depended on as a basis of historical truth, seem, however, in their derivations, to point to arrivals from beyond the sea, from a region where art and science had made some progress, and that those who communicated them became kings and chiefs of peoples whom they benefitted by their introduction. Ancient authors have supposed that the Pelasgians came from Thrace, but there is no proof of any civilization having then existed in that region. These authors knew nothing of this continent, or the religious worship, manners and customs of its people, or of any intermediate civilization which could have established affinities either with the aboriginal races, or the Pelasgians, or of their possible separation; or perhaps we might have handed down very different opinions, both as to affinities and derivation. From all this I have taken the liberty to assume.

I.—That wanderers of the Adamic stock peopled the coasts of Asia Minor and other parts of the Mediterranean, about the same time that wanderers of the same race were progressing towards the central portions of this continent.

II.—That some ages after them, either previous or subsequent to the time of the diluvial catastrophe in which Noah and his family were involved, a more civilized race arrived at the Mediterranean, and under the name of Pelasgians spread themselves through the wide extent of its coasts.

III.—That after the Noachian deluge, when the family of Noah, whose mission it was to give an impulse to civilization, had multiplied, branches of them arrived at and settled on the shores of the Mediterranean. Cush and Mizraim introduced their superior civilization into Egypt and Ethiopia. The Phœnicians or Kanaanites, another Hamitic race, were amongst the first arrivals. They appear more particularly to have understood the art of navigation, and to have come from the Persian Gulf by way of the Red Sea. The descendants of Japheth afterwards obtained a footing, and either by conquest or being deemed benefactors, acquired great influence, and became eponyms of various tribes.

It is remarkable as evidence of the unity of mankind, and their affinities, that these tribes or races of men, not far removed from each other in time, comparatively, readily amalgamated—that they spake dialects of one original language, which very soon became assimilated; and that this language, altered, matured and perfected through long past ages, still retains traces of derivation, that in the opinion of archæologists connects it with the aboriginal languages of this continent.

But while evidence of this nature shews that it might have been easy to pass into the Mediterranean from countries adjacent, and may be taken also as proof of the affinity of races, it is by no means conclusive with reference to a communication with this continent. It still remains to close the wide gap of ocean which separates the two hemispheres and their peoples—the most ancient as well as the most civilized. Here we shall find that tradition and fact combine to prove, that at some very remote period of the world's history, the facilities of communication must have been much greater than in more recent times; and that the disturbances which separated the continents, must have been caused by tremendous convulsions of nature in some instances, and in others by gradual sinking of the land. In connection with this subject it may as well be remembered that when nature depresses in one locality, there is always a corresponding elevation in another, nigh to or remote. The phenomena which has obliterated the lands of the Pacific Ocean between the tropics is very remarkable, and has been satisfactorily explained by modern science. What the whole amount of this subsidence may have been, or its effect in advancing or retarding the peopling of this continent, will never be known; but enough is revealed to enable us to estimate the greater by the less. Let it be remembered also, that the Pacific islands were very early inhabited, and that the nighest to this continent, Easter Island, where ancient remains have been found, is not further off than a few days sail, while between each across the ocean, a few days sail would establish consecutively, a communication. The affinity of the Polynesian with the Malayan, and with some of the American tribes on the Pacific side, may therefore, we think be conceded. For a description of this wonderful phenomena of subsidence, which appears to have been gradual, but which realized all the circumstances of a drowned world, I cannot do better than refer to Dana's Geology, where in connection with Coral Islands, it is thus adverted to.—

Dana observes,—"The Coral Islands of the Pacific are proofs of a great secular subsidence of that Ocean. The line CCC (Physiographic Chart) between Pitcairn's Island and the Pelews, divides coral islands from those not coral; over the area north of it to the Hawaian Islands all the islands are atolls, excepting the Marquesas and three or four of the Carolines. If then the atolls are registers of subsidence, a vast area has partaken of it, measuring 6000 miles in length (a fourth of the earth's circumference) and 1000 to 2000 in breadth. Just south of the line there are extensive coral reefs; north of it the atolls are large, but they diminish towards the equator, and disappear mostly north of it; and as the smaller atolls indicate the greater amount of subsidence, and the absence of islands still more, the line AA may be regarded as the axial line of the great Pacific disturbance. The amount of the subsidence may be inferred from the soundings near some of the islands to be at least 3000 feet. But as 200 islands have disappeared, and it is probable that some among them were at least as high as the average of existing high islands, the whole subsidence cannot be less than 6000 feet. It is probable that this sinking began in the Post-tertiary period. Since this subsidence ceased, for the wooded condition of the islands is proof of its having ceased, there have been several cases of isolated elevations."*

Although there is much less evidence extant of connecting links by the Atlantic between the two hemispheres, than by the Pacific, notwithstanding that the latter is the more expansive ocean, it is probable that a continuous land, or a chain of islands stretched from the Canaries to the Antilles in the remote past, where there is now a wide extent of ocean. The Canaries and the Cape de Verds lie in the same parellels with the West Indies and with the Pacific Islands. Hypotheses and tradition must here be largely drawn upon to supply the place of positive proof. The geological facts presume that the West India Islands are the high lands of a submerged continent. If so the subsidence must have been immense that once took place over this wide tract of ocean; but there is also evidence of compensating elevations even in the vicinity of the line

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* See Dana's Geology, p. 587.

of disturbance. The historian Edwards, before quoted, says—"Lofty as the tropical mountains generally are, it is wonderfully true, that all the known parts of their summits furnish incontestible evidence that the sea had once dominion over them. * * * Marine shells are found in great abundance in various parts of those heights. I have seen on a mountain in the interior parts of Jamaica, petrified oysters dug up, which perfectly resembled in the most minute circumstances, the large oysters of the western coast of England, a species not to be found at this time, I believe, in the seas of the West Indies." This fact would seem to indicate, that with a change in the height or continuity of the land, there has also been a change from a temperate to a tropical climate, which is deserving of more attention than has hitherto been bestowed upon it. It is also well known, that with few exceptions, all the islands are volcanic.

This mingling of hypotheses and fact is the basis that remains upon which to establish a connection between the Eastern and Western hemispheres, and is as strong on one side of the ocean as the other. The Azores, Madeira, the Canaries and the Cape de Verds, are supposed to be relics on that side of an ancient submerged continent—and of these the Canaries were at a remote period inhabited by an inoffensive and comparatively civilized race, who from their pursuits, for aught we know, may have been of the lineage of the people of the Antilles, or the ancient Egyptians. The inhabitants of the Antilles, exclusive of the Caribs, had affinities of customs with this race. Both made mummies of their dead by a similar process. Their mode of embalming was not that of the scientific Egyptians, but was far simpler and perhaps as efficacious. They dried the dead bodies in ovens, by gradual heat, and when this was done they ranged them in a sitting posture side by side, in caves, and so handed them down to posterity. Whether they communicated this idea, or were indebted for it to some accidental arrival of Egyptians who imperfectly understood the process, we are left to conjecture. They had other customs which appeared to connect them with the most ancient races of the Eastern hemisphere—rites resembling those of the worship of Bacchus, which so infatuated the nations among whom they were introduced. These appear to have been observed more or less among all the American tribes. Other worship or mysteries they had, analogous to those of Cybele. Both Bacchus and Cybele I take to be of pre-Noachian age and corruption. The Guanches of the Canary Isles appear to have had much skill in architecture, of which remains (which are noticed by Pliny) exist to attest to their material progress.

Tradition has been busy in all ages with this region and the surrounding ocean, and its influence upon the human mind is as powerful as ever, now that the investigations of ethnologists have shown the possibility that it may be well founded. The Fortunate Isles (the Canaries) were supposed to be a portion of the lost continent long previous to the discovery by Columbus west of the same parellels. They are not more than twenty days sail of the Antilles. The Elysian Plains had become the Isles of the Blessed, in the Western Ocean, in the time of Hesiod. Plato, who obtained his information from the priests of Egypt, gives a description of the island of Atlantis, supposed to have existed at a very early period in the Atlantic Ocean. He relates as follows: "In the Atlantic Ocean over against the Pillars of Hercules, lay an island larger than Asia and Africa taken together, and in its vicinity were other islands and a large continent beyond. The Mediterranean compared with the Ocean in which these lands were situated, resembled a mere harbour with a narrow entrance. Nine thousand years ago, before the time of Plato, this island of Atlantis was both thickly settled and very powerful. Its sway extended over Africa as far as Egypt, and over Europe as far as the Tyrrhenian Sea. The tradition of an ancient Athenian State, anterior to the deluge of Deucalion is also related, which was governed by laws not unlike those of Egypt. The Athenians (said this tradition) made war at this remote period against the inhabitants of Atlantis, and defeated them. After this a violent earthquake, which lasted for the space of a day and a night, and was accompanied with inundations of the sea, caused the islands to sink, and for a long period subsequently the sea in this quarter was impassable by reason of the slime and shoals. A certain Marcellus related a similar tradition with that of Plato. According to this writer there were seven islands in the Atlantic Ocean sacred to Proserpina, of these three were of a very large size, and the inhabitants had a tradition among them that they were originally one large island which had ruled over the rest."

Since the discovery of this continent many authors find America in the Atlantis of Plato. Anthon, from whose excellent Classical Dictionary I have extracted the foregoing from ancient authors, says for himself—" The advocates of this theory might easily connect with the legend of the lost Atlantis, the remains of a very remote civilization that are found at the present day in Spanish America. We have there the ruins of cities which carry us back to Pelasgic times, and the religious symbols and ornaments connected with which remind us strongly of the phallic mysteries of antiquity. Even the lotus flower, the sacred emblem of India (he might have added the elephant also) may be seen in the sculptures. These curious remains of former days are long anterior to Mexican times, nor have they anything whatever to do with Phœnician settlements, such settlements on the shores of America being purely imaginary. In connection with the view just taken we may point to the peculiar conformation of our continent along the shores of the Gulf of Mexico, where everything indicates the sinking at a remote period of a large tract of land, the place of which is now occupied by the waters of the Gulf. * * * The mountain tops of this sunken land still appear to view as the Islands of the West Indian group, and thus the large continent lying beyond Atlantis, and the adjacent islands, and to which Plato refers, may have been none other than that of America. We proceed a step further. Admitting that Atlantis was situate in the Ocean which at present bears its name, it would require no great stretch of fancy to suppose that the Canaries, Madeira isles and Azores once formed portions of it, and that it even extended as far as Newfoundland. The Cape de Verd islands, though so much to the south, may also be included."

Thus far hypotheses, tradition and fact, with reference to an exceedingly remote connection between the races of the Eastern and Western hemispheres, and then its disruption. If it were granted there need be no further controversy about the unity of mankind; and the affinity of the races of Europe, Asia and America, separated in the early age of the world, by tremendous convulsions of nature, and left, each in its own way, to fulfil its destinies, may just as well be conceded.

Hitherto I have said nothing of Scripture testimony to the existence of this lost continent, nor does it embrace anything that is directly significant thereof. It might however be expected, were there any foundation for the tradition, that we should find some reference thereto in the Bible. Well, we cannot feel sure that the whole history of man, as there recorded, is not in fact a history of Atlantis. It is not precisely defined where Paradise was situated, nor its limits and bounds declared with any degree of probability. The question has never yet been satisfactorily solved. It is therefore quite useless to attempt, by any fancied resemblance in the world that is known, or by any process of reasoning, to identify the Eden of the world that was destroyed. All the migrations of the earliest race of mankind point to the east of Eden as the region that was inhabited after the forced departure from that blissful seat. East of Eden to the land of Nod, Cain emigrated, ceased his wanderings and built a city. The other children of Adam occupied a country perhaps not far distant, as a similarity of names and a limited genealogy of Cain's descendants and other evidence, make an amalgamation of the races tolerably certain. It is not so difficult to mark the probable resting place of the ark after the deluge, but even that, modern science, based upon the Scripture relation, has changed from a belief anciently entertained, to a site more in accordance with Scripture history as well as tradition. The journeying from the east of the descendants of Noah, who had greatly multiplied, was no insignificant exodus from that site; and their arrival at the plains of Shinar, does not imply that the Armenian Ararat was the resting place of the Ark.

But we can if we please, and without doing violence to any belief, with what is known of the lands that are left on both sides of the Atlantic, with what we may conjecture of the convulsions that have separated them and their races, and various species of animals, and reduced them to their present condition, conclude that

Atlantis may have been the scene of man's creation. The climate, the rich productions, the mineral wealth, the volcanic strata of these beautiful islands, favour the conclusion.

Here may have been the region where God planted a garden, and placed Adam, and then Eve, to keep it, and where they roamed *naked*, the man and his wife, and were not ashamed. In this delightful country we may draw upon imagination, without fear of satiety, for a picture of the lost Paradise, and the fiery obstructions to its ever being regained. Beyond it, in the genial climate and fertile soil, we can look upon Adam, in the sweat of his brow, tilling the ground from whence he was taken, and which God had cursed. Soon thereafter, Cain, the first murderer and emigrant, and his brother Abel, come upon the scene. We find the first born bringing his presumptuous offering of the fruits of the ground, not as an acknowledgment of Divine mercy in still permitting it to maintain the human family, but as an earnest that it yet bare something in that propitious clime, more akin to the products of Eden than "thorns and thistles"—an offering, in the spirit in which it was made, to which the Lord had not respect. We can judge of what his remorse must have been after the fatal act that brought death into the world, and made him a fugitive and a vagabond on the earth, and can hope for him that in after life he received consolation from the Divine declaration "If thou doest well shalt thou not be accepted." Ages roll on, mankind multiply exceedingly, the longevity is remarkable, although we know nothing of the measure of time in the antediluvian age. The tree of knowledge bears its fruit in the human mind; art and science progress. Iniquity also abounds although it had not yet culminated. Men worshipped the true God and called upon his name. Polygamy prevailed as in later ages. We find Lamech with his wives Adah and Zillah, endowed with superior talents, coupled with a certain ferocity of disposition characteristic of the period, showing even then the insecurity of human life. Lamech who had slain a man by whom he had been wounded, and a young man from whom he had received a hurt,—probably not innocent blood as was that of Abel—deprecating revenge, or claiming exemption from retributive justice, on the plea which preserved his great ancestor—"If Cain shall be avenged seven fold, truly Lamech seventy and seven fold." The world progresses in civilization, but faster in sin. This episode of Lamech and his family is a rare study for the archæologist. It is the sixth generation only from Adam, and yet marks an era of progress. The nomadic or shepherd life is followed by Jabal the son of Adah, who possesses domestic cattle—his brother Jubal has invented musical instruments. Tubal-cain the son of Zillah has discovered the composition of bronze, and has made iron subservient to the uses of man—which implies a previous discovery of the metals themselves. The Jews have a tradition that his sister Naamah invented weaving. These early instances of progress do not warrant a belief that the primitive race of men were ever in that rude and savage condition, to which long continued wanderings had afterwards reduced them, and to which the remains of stone implements and the kjokkenmoddings of the north of Europe attest that they had at length arrived. The story of Lamech is not tradition but actual occurrence. It bears intrinsic evidence of having been written and handed down, as do all the events recorded from the Creation to the Noachian Deluge. Viewed in this light philology may have made progress during that epoch, and if so we need not wonder at the perfection of written language to which some of the most ancient nations attained in a comparatively short period after the latter event. Between Lamech and Noah there were many generations of this primitive race, as is testified by their genealogy in a direct line; but it would be absurd to suppose that in all that long period from Adam to Noah, the human family had not spread to every part of the world—to this continent north and south on the one hand—to Africa, Asia and Europe on the other. When their wickedness had culminated at the primitive seat, and Noah had endeavored in vain to restrain and reform them, he was commanded to build an Ark, and the intelligence was communicated that man would be destroyed from off the face of the earth. Portentous disturbances must have given force to his warnings, and confirmed his belief—volcanic eruptions, earthquakes, subsidences, overflowings of the dry land—as in the West Indies and Central America at the present day—their very frequency perhaps, short of general disaster, inspiring confidence in personal safety. They went on, eating and drinking, marrying and giving in marriage, until the Flood came and destroyed them all. Then the windows of heaven were opened, the fountains of the great deep were broken up, and the rain was upon the earth forty days and forty nights. This catastrophe is very particularly stated to have commenced in the six hundredth year of Noah's life, in the second month, the seventeenth day of the month. Fifteen cubits (27 feet) upwards did the waters prevail, or the land subside to that extent, and the mountains were covered. It is a remarkable coincidence as concerns the Atlantean hypothesis, that Josephus determines the year at the Flood to have begun about the autumnal equinox; thus the 17th day of the 2nd month (Marchesvan) would fall in our October, about the time when the rainy season begins in the West Indies. The historian Edwards, whom I have so frequently quoted, thus describes that phenomena:—"An European who has not visited those climates can form no just conception of the quantity of water which deluges the earth at this season,—by an exact account which was kept of the rain which fell in one year in Barbados [1762,] it appeared to have been $87\frac{1}{100}$ cubic inches, equal to 7 feet $3\frac{1}{100}$ inches perpendicular. Taking the whole islands throughout, from 60 to 65 inches appears to be about the medium of rain in seasonable years. If this quantity should annually fall in England, the country would be deluged, and the fruits of the earth destroyed. The power of the sun at that distance from the equator would be too feeble to exhale a sufficient quantity of it. Earthquakes also are not unfrequent; but none have been productive of mischief since the fatal one of June 1692, which swallowed up Port Royal." To which I may add, that perhaps the judgment on Port Royal for its wickedness was as just as that which destroyed the posterity of Adam many thousand years previously, and obliterated the continent which they had inhabited for so long a period.

The immediate result of this great cataclysm was the transpor of Noah and his sons to a region whose climate and productions differed considerably from those of the country of endless summer from whence they were tempest-driven. The conditions expressed recognize a temperate clime, such as may well have existed in the central parts of Asia. The olive grew there, for the dove returned to the ark with an olive leaf plucked off. They there received a promise from the mind of the Lord, that *seed* time and *harvest*, and *cold* and *heat*, and *summer* and *winter*, and *day* and *night* should not cease. A rainbow was given as a token of this covenant. Noah became an husbandman and planted *a vine*. If in addition to this it is credible that the African desert in these latitudes was then a wide ocean—that the Mediterranean sea spread over a much larger surface than at present—that the land of Egypt was submerged—that the Red Sea and the Persian Gulf extended where there is now dry land—we may have the compensating elevations; and I see no difficulty then in further supposing, that after a drift eastward of more than 150 days, during which the waters prevailed—the ark may have rested on one of the heights of the Hindoo Coosh—the distance involved being equal to about one fourth of the circumference of the Globe in these latitudes.

We know that in this invigorating climate mankind multiplied exceedingly—that in a few generations they journeyed thence a host—that after some time they arrived and settled at the Plains of Shinar—that with inconceivable stupidity, as appears to us, but wondrous energy, a token of an impious design, they commenced to build a tower whose top should reach unto heaven. That Nimrod became a mighty hunter before the Lord, built cities and established a kingdom, &c., &c., &c.

Thenceforth the history of the Noachian family is the communication of progressive civilization wherever they extended themselves amongst the rude tribes of mankind—improvement, with all the knowledge of art and science conveyed thereby, entirely confined to the Eastern hemisphere. If the true history of the Creation of man and of the Deluge was thus spread abroad—if none escaped the Noachian catastrophe to this side, of those who were involved in it, accidental arrivals of some of the descendants of Noah—Assyrians, Egyptians, Phœnicians, Jews, or Greeks, &c. may have impressed imperfect accounts of those truths, along with elements of civilization, upon some of the pre-existent tribes of the western continent, and given rise to traditions and beliefs extant at the time of Columbus—but which, be it remembered, were considered only with reference to their own ancestry. As the question stands, all the

General Meteorological Register for 1872.

HALIFAX, NOVA SCOTIA.

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

OBSERVED BY F. ALLISON.

1872.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year 1872.
Mean Temperature	23.64	23.99	22.91	37.88	46.22	57.14	64.77	64.12	58 60	48.94	37.71	22.23	42.35
Difference from Normal (ten years)	+.72	+.33	-5.22	-.25	-1.16	-2.52	+1.29	+.87	+1.16	+.69	-.10	-3.56	-.75
Maximum Temperature	45.1	42.6	46.8	62.2	71.0	87.3	88.8	93.1	84.8	71.1	58.3	47.2	93°.1
Minimum Temperature	-2.2	4.9	-5.2	19.5	28.2	38.4	48.3	47.9	42.8	31.1	19.8	-5.4	-5.4
Monthly and Annual Ranges	47.3	37.7	52.0	42.7	42.8	48.9	40.5	45.2	42.0	40.0	38.5	52.6	99.5
Mean Maximum Temperature	31.15	32.45	33.25	46.57	56.94	67.55	77.69	74.78	69.44	58.45	44.41	30.37	51.99
Mean Minimum Temperature	16.46	20.89	13.77	30.64	38 69	48 81	55.14	56.45	50.92	39.61	30.11	14.27	34.65
Highest Daily Mean Temperature	41.58	32.30	35.77	46.09	57.96	72.59	73.11	73.32	68.62	62.60	49.69	41.56	73.32
Lowest Daily Mean Temperature	4.64	9.85	8.36	31.22	37.82	42.95	57.91	58.95	53.63	36.76	26.40	-1.49	-1.49
Mean Daily Range of Temperature	15.00	16.76	19 47	15.93	18.25	18.74	22.55	18.32	18.52	18.37	14 30	16.10	17.69
Greatest Daily Range of Temperature	27.2	31.2	32.9	28.5	33.8	31.1	31 00	32.7	28.5	27.5	24.3	29.7	33.8
Mean Terrestrial Radiation	....	....	....	28.76	37.27	47.92	53.06	54.65	49.32	37 29	28.32	... ...	....
Mean Pressure, corrected,	29.657	29.659	29.605	29.694	29.754	29.810	29.758	29.881	29.879	29.912	29.793	29.787	29.766
Difference from Normal (ten years)	-.076	- 103	-.113	-.031	+.055	+.053	.000	+.113	+.037	+.105	+.064	+.052	+.004
Maximum Pressure	30 435	30.461	30.239	30.197	30.258	30.174	30.094	30.194	30.314	30.449	30.417	30.452	30.461
Minimum Pressure	29.038	28.833	28.785	29 089	29.213	29.406	29.484	29.426	29.366	29.301	28.856	28.941	28.785
Monthly and Annual Ranges	1.397	1.628	1.454	1.108	1.045	0.768	0.610	0.768	0.948	1.148	1.561	1.511	1.676
Highest Daily Mean Pressure	30.416	30.339	30 169	30.151	30.228	30.149	30.054	30.073	30.291	30.379	30 267	30.102	30.416
Lowest Daily Mean Pressure	29.203	28.972	29.210	29.178	29.313	29.471	29.568	29.461	29.428	29.403	29.042	29.084	28.972
Mean Pressure of Vapour	.113	.110	.103	.166	.254	.395	.451	.494	.404	.288	.184	.111	.256
Mean Relative Humidity	80.2	80.1	76.4	73.2	80.9	83.4	74.5	82.9	81.6	79.3	78.7	82.5	79.5
Mean Amount of Cloud	6.04	5.79	5.82	5.82	7.49	7.15	5.07	6.57	5.49	4.78	6.57	6.22	6.07
Difference from Normal (six years)	-.37	-.34	-.03	-.46	+.62	+1.22	-.50	+1.15	-.24	-.68	-.19	-.39	+.06
Prevalent Direction of Wind	N.W.	N.W.	N.N.W.	N.N.W.	N.	S.E.	N.W.	S.W.	S.W.	S.W.	N.W.	N.W.	N.W.
Mean Velocity of Wind	11.98	12.36	16 05	13.77	11.02	6.07	2.12	2.58	3.61	4.18	9.30	5.84	8 24
Amount of Rain	2.58	2.40	0.76	2.77	4 44	4.23	2.88	6.82	1.41	4.88	6.23	2.87	42.27
Difference from Normal (ten years)	-1.08	- 99	-2.15	-.33	+.27	+1.19	+ 51	+3.21	-2.28	-.14	+1.55	-.57	-.81
Number of days Rain	7	4	1	7	17	18	11	13	8	13	13	4	116
Difference from Normal (ten years)	+ 1	- 2	-4	-3	+2	+5	+1	+2	-2	+1	+1	-4	-5
Amount of Snow	13.1	19.3	43 0	0 8	Inap.	0	0	0	0	0	4.4	32.3	112.9
Difference from Normal (ten years)	-2.5	+5.2	+23.8	-6.9	-.1	0	0	0	0	-.5	+.1	+15 3	+33.9
Number of days Snow	6	8	11	1	0	0	0	0	0	0	6	15	47
Difference from Normal (ten years)	4	0	+3	-4	-1	0	0	0	0	-2	+2	+4	0
Total Precipitation	3.88	4.49	5.37	2.85	4.44	4.23	2.88	6 82	1.41	4.88	6.65	6 16	54.06
Difference from Normal (ten years)	-1.59	-1.18	+.85	-1.13	+.26	+1.19	+.51	+3.21	-2.28	-.23	+1.49	+1.25	+2.31
Number of Dry Days	21	18	19	22	14	12	20	18	22	18	13	13	21.0
Difference from Normal (ten years)	+ 4	+2	+1	+4	-2	-5	-1	-2	+2	-2	-2	-1	+4
Number of Auroras	4	4	5	5	2	9	6	4	6	6	3	1	55
" Gales	1	3	8	6	1	1	0	0	0	0	4	2	26
" Fogs	3	2	1	2	7	10	5	9	1	4	0	3	47
" Dews	1	0	0	1	5	3	17	18	24	18	4	0	91
" Hoar Frosts	11	13	8	9	2	0	0	0	0	9	10	9	71
" Thunders	0	0	0	1	2	5	3	0	1	1	0	1	14
" Lightnings	0	0	0	1	2	5	5	2	1	1	0	1	18
" Hails	0	0	0	0	0	2	0	0	0	0	0	0	2
" Rainbows	0	0	0	0	1	2	1	0	0	0	0	0	4
" Lunar Halos	4	1	0	1	1	0	0	0	0	1	1	0	9
" Lunar Coronæ	1	2	3	2	1	0	1	0	2	1	3	1	17
" Solar Halos	0	0	2	0	2	3	0	1	1	0	4	0	13
" Days Sleighing	15	29	31	4	0	0	0	0	0	0	0	19	98

affinities of the American races with those of the Eastern hemisphere, which are relied on to establish the unity of mankind, are evidently of a much earlier period, and can be predicated with greater certainty, than those which are adduced to show a derivation of the former from the ancient civilizations with which history makes us acquainted.

We must await with patience the complete solution of the problem. Through the researches of learned men the early history of mankind is becoming better known than heretofore. The obscurities of mythology and tradition are being permeated by the light of science and the evidence of facts. In our own day, we know more perhaps of primitive and prehistoric man, and can speculate with more probability upon the operations of his mind, than the ancients themselves. To use the language of one of the followers of the celebrated African traveller, Dr. Livingstone, who had just got a glimpse of the wonders of civilization—"We are the ancients, and all that has gone before us is but as of yesterday."

Art. X. — On the Progress of Weather Knowledge. By Frederick Allison, Esq.

(*Read May* 12, 1873.)

In 1848—now a quarter of a century ago—I began taking some observations of Temperature in this Province in a very rude manner, with an ordinary thermometer fastened to the side of a large building. I thus detail my own beginning, as it happens to coincide with that of many others; and the experience of a large number of present regular observers is similar.

In Nova Scotia, and even in all parts of the Continent of America, observations of climatic phenomena were then in their infancy. The Smithsonian had initiated a good work at Washington, but the best position of instruments, their construction, and hours of observing, were known to comparatively few. The British Government had established the Toronto Magnetic Observatory, where meteorological phenomena were also observed, and thus laid a foundation for the system now developing through Canada; but the most simple laws of weather were yet disregarded by the public. I do not intend to allude to Great Britain and Europe just now, beyond saying that the difference between the knowledge of then and now, is fully as marked in those countries.

In 1873 how different is the condition we find ourselves in. Not looking, at the moment, at the other Provinces, I have in this Nova Scotia alone, regularly reporting to me monthly, these stations of weather observers, viz: Yarmouth, Digby, Wolfville, Windsor, King's College, Beaver Bank, Truro, Pictou, Cape North, Sydney, Glace Bay, Cow Bay, Guysboro', Seaforth, and Halifax; besides St. John's, Harbour Grace, Fogo and George's Bay in Newfoundland; and Charlottetown in Prince Edward Island —while four other Nova Scotian stations are, I hope, only temporarily discontinued—making twenty-four in all. But the multiplication of observers is but one evidence—and a slight one—of the progress of weather knowledge. The knowledge gained of the instruments of our equipment has been immense; of course this information has been mostly obtained from abroad, chiefly from the experience of the scientific workers of Great Britain.

The placing these instruments in the best positions to obtain equitable readings has occupied a large share of the attention of many meteorologists. Our own Chief Director, G. T. Kingston, at Toronto, has made some valuable improvements and suggestions in this respect. In the Barometer, one of the earliest instruments in connection with our science, comparatively little improvement has been necessary. The addition to it of a recording apparatus— in fact making a Barometer also a Baragraph—is to it, what it may be called to all instruments, a mechanical adjunct rather than a scientific improvement. Apart from self-registration, the Fortin Barometer with metallic scale, tube not less than 0.4 inch internal diameter, and zero of scale adjustable by reflection of inverted cone in cistern, when mounted plainly and in a room of equable temperature, and read by a Vernier, seems to leave little to be desired in the primary and useful instrument.

Perhaps no greater injury is done to the establishment of climatic truths than by the use of erroneous Thermometers. It is so easy to throw a portion of mercury into an ordinary glass tube and attach the latter to a scale graduated carelessly, thereby manufacturing an interesting but pernicious toy—while it is comparatively difficult to expend the necessary time, skill, and money upon a true Thermometer, that we can scarcely wonder at the very wonderful pieces of mechanism which are popularly received as measures of Heat. I have several times found so-called Thermometers differing from the standard full seven degrees, while scarcely two Thermometers taken haphazard from a large stock will agree exactly. Our climate is quite liable enough to extraordinary changes of Temperature without our calling in art to assist nature in that respect. At our first class stations we use no Thermometers whose readings have not been compared with a verified standard. A large bulb in free air, narrow tube, porcelain scale, without backing, and the graduations carried across the tube itself, are essential to correct marking and reading. Makers of whom I can by experience speak as very good, are Casella, Negretti and Zambra, of London; Acrè, of Edinburgh; and Green, of New York. The wet and dry bulbs, and maximum and minimum registering Thermometers should be placed about five feet above ground, sheltered on all sides from direct, reflected, or refracted sun's rays; under a screen constructed with slats, or louvre boards on three sides, and to the south of two layers of boards or fences, at intervals of several inches.

Having merely glanced at the principal instruments now in use by meteorologists, I pass on to discuss for a short time the effects so far obtained in this country from the systematic observations now established. It is evident that the primary objects of continued series of meteorological observations is a settlement of the normal climate of the country—especially in its chief elements of Temperature, Pressure, Wind and Precipitation. Having learned the mean condition of the place and the extremes to which it is liable, the organic life, the animal and the vegetable customary to the climate, and possible under such conditions, may be more readily ascertained. But it has been proved that very frequent observations of Pressure and Temperature—say hourly, or even tri-hourly, are not absolutely required at more than one station within a large extent of country. Stations at which these frequent readings are taken are called in the Dominion Organization "Chief Stations," and embrace at present seven cities, to which number but few more need ever be added, except in Manitoba and British Columbia. From these chief stations the variations for the ordinary posts may be calculated with sufficient exactitude.

Besides the determination of the regular and extreme climate at any given point, another very important object is the connection of the differences between two such points; in other words, their relative bearing upon each other. This consideration is very useful in summing up the probabilities of ensuing weather. Before this audience I need not dwell upon the importance of weather forecasts, beyond the mere gratification of the restless curiosity, natural to the human kind. To encourage the advancement towards certainty in this direction, should be the effort of every one who tills the ground and who feeds upon the produce of that tillage; of every one who lives by the traffic of the sea, and earns his meat by toiling over the boisterous waters—a life peculiar to so many of the inhabitants of our wave-washed Province. Such knowledge should in brief be striven after by all mankind. This comparison of different climates and its result, the determination of atmospheric changes, and storm paths, make necessary the telegraphic branch of meteorology now just emerging into existence in this Dominion. That such information can be obtained, and climatic laws therefrom deduced, as will ultimately bring the forecasting of coming weather very near perfection, no one who has carefully observed the directions of atmospheric fluctuations can for a moment doubt. For instance, at noon on Friday last the 9th inst., what weather could be more fair than that enjoyed then in Halifax. A sky perfectly clear, a barometer standing high at 30.255 inches, temperature 66.5—the mildness of a well advanced spring—a gentle northerly breeze, and to a superficial gaze every promise of a continuance of fair weather. True, a certain haziness of atmosphere giving unnatural distinctness to some substances, and bringing apparently nearer remote objects, might have warned the man versed in local signs of a coming change; though apart from scientific grounds he could give you no satisfactory reason for his suspicion. Also the Barometer had fallen somewhat from the greater height of the preceding day; but was still much above the normal, so that those trusting only to its bare and uncompared reading could not reasonably expect bad weather. But the telegraph told us of heavy rain and high N. E. wind at New York, and of threatening clouds farther east and north that morning; of eastwardly rain and heavy clouds again down the St. Lawrence Valley—all Barometers to our immediate west falling fast. The limits of this paper would not suffice to set forth the details of reasoning from proved scientific truths leading to the belief of a N. E. progression of this rain and wind, but recognizing the almost sure consequences of the above facts, and convinced by them of the usual cyclonic nature of the disturbance, I anticipated the S. E. wind, and rain present in Halifax on Sunday, and doubtless fresh in the recollection of my hearers.

Farther, regarding Telegraphic Meteorology, I am in hopes that, taught by experience gained from European and American systems, Canada may be able to improve on both of these. I must consider the practical working of the British Meteorological office superior to that of Washington; but, happily for us, we are so situated politically, geographically, and meteorologically, that we may introduce much of their cautious system into our Country with greater facilities for its successful use. Especially does it seem prudent for us in the infancy of our organization to provide that the drum (the best method of warning of probable storm) be hoisted for a period of forty-eight hours as in Great Britain, rather than follow the constantly changing bulletin of the United States. The greatest difficulties that we have to contend with here, are the want of more numerous ordinary and reporting stations—the want of longer series of observations even at the best of our posts, and the imperfect arrangements of the Telegraph Companies. The first want I trust may be soon remedied, that more volunteers may be encouraged to assist in advancing the public knowledge of all branches of meteorology. With their assistance Barometrical gradients can be established, and all the varying elements continually studied, until a much more thorough knowledge of the comparative pressures, temperatures, &c. may be obtained, and a two-fold benefit is derived from these, viz: first, the determination of general comparisons between all stations—neighbouring and remote—and second, in telegraphing opinions and warnings, the progressive rate of changes going on at any particular time may be accurately marked and their arrival at the various points predicted within very narrow limits. The second need is very important—longer series of observations—the use of those in general is at once evident; if seven years readings are good in calculating normals, eleven years are better. But a specific use of prolonged series is to fix more accurately the occurrence and effect of abnormal phenomena, and thus, in studying the probable appearance of any change at a given station, to be able not only to form an opinion from established laws affecting a whole Province, or even a larger portion of the Continent; but to eliminate from those wider deductions, errors which may arise from individual position, and to give their full value to local circumstances whose influence may not be felt for more than a few miles, but within that small area may be quite sufficient to induce purely local phenomena, or even to divert from its course the whirling storm at one time, while at another they cease to exist and leave the district entirely controlled by the relative conditions normal within itself and adjacent areas.

The last obstacle I mention is one readily susceptible of great improvement, being a purely mechanical defect; and I believe that when once the whole importance of these labours is publicly appreciated, and Government is seriously extending a thorough scheme, the owners of Electric Telegraph Lines will also give to these bulletins and warnings the necessary facilities of transmission, causing the telegrams between Toronto and Halifax to occupy much less than the four or five hours, which I regret to say is at present consumed over that distance.

Without elaborating the very fruitful subject of prospective meteorology, I close this hurried paper by summarizing the progress of weather knowledge in Nova Scotia as an advance from the efforts of a couple of observers in 1869, to the establishment of 24 stations in 1873, placed now in connection with the Canadian Government System, included in the department of one of the most intelligent and hard-working ministers—Hon. P. Mitchell of the Marine and Fisheries—who successfully carried through Parliament at its present Session a grant of $37,000 for meteorology; and under the chief directorship of G. T. Kingston, M. A.,—head of Toronto Observatory—whose guidance and extensive scientific attainments are sufficient guarantees for our future successful progress.

ART. XI. THE HISTORY OF A BOULDER. BY THE REV. D. HONEYMAN, D. C. L., F. G. S., &c.

(*Read May* 12, 1873.)

OUR Boulder lies partially interred on the side of the road, between New Glasgow and Antigonish, about a mile and a half east from Sutherland's River Bridge. It is nearly thirteen years since this boulder first attracted my attention. Its hard weather-beaten face was traversed by a dark brown line which led me to suspect that it had a history to relate, which had yet been untold. In shorter time than I have taken to pen these sentences, my hammer and chisel had verified my conjecture. A familiar hieroglyphic appeared which at once informed me that the boulder was not a thing of yesterday,—that it had been clay deposited at the bottom of the ocean,—that it had been deposited there in an age long gone.

The hieroglyphic was the pygidium of a trilobite—*Dalmania Logani*—which lived, died, and was buried at nearly the close of the Upper Silurian Period,—which is known by English Geologists as the Upper Ludlow, by American Geologists as the Lower Helderberg, and by ourselves as the upper part or D, of the Upper Arisaig Series. I observed that this boulder was not solitary; many smaller ones were scattered on the sides of the road and in the fields: all were alike weather-beaten. Many enclosed beautiful forms—beautiful, but brittle. Trilobites, *Phacops* and *Prœtus* and *Homalonotus*, of a new and undescribed species. There were heads of *Phacops* having eyes in a beautiful state of preservation.

All told the same story as the tail of the *Dalmania Logani*—

Hall. The abundance of boulders led to the belief that the rocks which produced them were at no great distance. Shortly after the discovery of the boulder, I had made another discovery. In a road cutting, at the bridge of a branch of French River, east from the site of our boulder, are soft shales locally known as "pencil stone." In these I found *Graptolithus Clintonensis*—Hall. This is the only locality where this fossil has been found away from Arisaig. It indicates the Clinton age of New York, or Middle Silurian. In addition these shales produce several trilobites—several braehiopods, *e. g. Leptocoelia intermedia*—Hall, *Leptaena depressa*, *Lingula oblonga*, *Discina*, *Cornulites*, or tubiculous worms, a *Conularia*, *Pteropods*, and an *Orthoceras*, a cephalopod. This, I have elsewhere named Upper Clinton, B'.—In another road cutting at Barney's River, and yet another on a branch of the same river, to the east, I found abundance of nodules—all with one or two exceptions encasing beautiful *Lingulæ* of several species. This is the second of three localities where beds of *Lingula* nodules have been found. The first is Arisaig, the second is Barney's River, and the third Sutherland's River. These shales I have in my "Geology of Arisaig" characterized as B, and elsewhere as Lower Clinton.

In the bed of French River and at the road side at Barney's River, I found boulders with *Petraia*, and trumpet-shaped *Cornulites*. Here was evidence of the existence of still lower strata, or the A strata of Arisaig. After search the strata whence these were derived, were found up Barney's River. Here was bold and solid strata, forming flanks of the mountains. Here I found nearly as great a variety of fossils, as in the corresponding strata A of Arisaig.—These are found extending eastward to Marshy Hope, and westward to French River. They underlie the Lower Clinton and Upper Clinton shales, already referred to, and overlie Crystalline rocks—Syenites, Lower Arisaig Series.

The Clinton strata from Marshy Hope to French River, westward, are overlaid by Lower Carboniferous. Here, then, there is an irregularity in succession—the Upper Silurian and Devonian being absent.

The strata which produced our boulder yet remained undiscovered.

When surveying the Precarboniferous rocks of the Pictou Coal Field, in 1869, I found strata to the east of Sutherland's River, about three miles south of the boulder. These dip northerly at a very low angle, and are of the age of the boulder, having the same fossils. It is doubtless from some part of these that the boulder came. Their extension in the direction of their dip would underlie the boulder at no great depth.

The *Homalonotus* which I have already referred to is characteristic of the part of the Upper Arisaig Series, which has been determined by Mr. Salter, the late distinguished Palæontologist of H. M. Geological Survey, to be the equivalent of the Aymestry limestone of Wales. There is probably the other member of the upper part of the Upper Arisaig Series in the locality yet undiscovered. So that between Sutherland's River and Marshy Hope* we have probably the whole of the Upper Arisaig Series with the exception of the lowest, or Arisaig Pier portion, which I have regarded as the *possible* equivalent of the Oneida conglomerate of the United States.

Our boulder strata and those underlying them, were formed in the bed of the ocean, at ever varying depths, from the *detritus* of the Crystalline rocks of the Lower Arisaig Series, which I have already referred to as underlying the *Petraia* strata up Barney's River.

The boulder also tells us that it has undergone great hardships since it was deposited at the bottom of the ocean. When trying to detach a piece of the rock along with the fossils, I found that it would only break at right angles to the line containing the fossils. This tendency is called *slaty cleavage*.

Now this indicates that the original strata of the boulder with those underlying it, had been *let down* deeper than when deposited and subjected to heat as well as hydraulic or other pressure, and had consequently been metamorphosed. The preservation of the

*At the entrance to the Marshy Hope there is an outcrop of Arisaig A. (Mayhill sandstone) belonging to the Antigonish Mountain, a Marshy Hope Series. This is overlaid directly by part of the conglomerate of the Merigomish Carboniferous formation. So that along the line of junction of the Precarboniferous and Carboniferous formations of Merigomish, we have an irregularity of a accession corresponding with that observed in the Pictou Coal Field. Vide "Transactions" 1870–71.

fossils, however, shews that this metamorphism has not been of the highest degree. Having been subjected to this process for a long period, or while the Devonian age lasted, the hardened strata were raised from the depths before the commencement of the Lower Carboniferous Period.

The *Boulder* strata form the eastern extremity of the Precar boniferous strata, underlying the Carboniferous area of Merigomish.

I have already stated that the Carboniferous formation directly succeeds the Clinton strata, between Marshy Hope and French River. We have now the same directly overlying the Upper Silurian. Here then is another irregularity in succession.

The strata of our subject were thus exposed to the stormy seas of the Lower Carboniferous Period—their detached fragment, rolled on the shore, aided in the formation of the materials of the conglomerate which now overlie these strata. This conglomerate is very ferruginous and contains a bed of spathic iron ore, which is considered to be of economic importance.

Outcrops of trap rising in the conglomerate show that our boulder had a narrow escape from local metamorphism. If it had been subjected to this ordeal in addition to regional metamorphism, the line which distinguishes it might have been converted into a streak, and an important part of its history would have been wholly illegible, also the boulder itself would have failed to attract particular attention.

The absence of the usual Lower Carboniferous Lime and Gypsum, appears to indicate that the existing conditions were unfavorable for their deposition.

The coal beds of Merigomish Island show that a Tropical vegetation once crowned the succeeding strata, while the thinness of the beds seems to indicate that the vegetation was far from being luxuriant or lasting.

The extension of these Palæozoic strata became the foundation of a new order of things, the New Red Sandstone, Mesozoic or Triassic formation of Prince Edward Island.

Previous to this, however, or during the Carboniferous Period, time of incalculable length had passed. Elsewhere the Carboniferous formation exhibits many oscillations of level, alternations of water and land, aquatic Fauna and terrestrial Fauna and Flora, periods of vegetation of tropical character and marvellous luxuriance, forming beds of coal varying from extreme thinness to enormous thickness.

After the formation of these beds, there appear to have been troublesome times, especially in the vicinity of our boulder position. These times have left enduring memorials in the adjoining Carboniferous area, the Pictou Coal Field. The map of the Geological Survey of Canada indicates a network of faults and troubles in this locality.

One consequence of all this appears to have been a limitation of conditions favorable to the formation and distribution of the deposits of the Triassic Era ; as the only area possible from the boulder point of view, is that of Prince Edward Island.

In this Triassic region, there lived, died, and were buried, *Dinosaurs*—formidable reptiles, having "ornithic or bird affinities ;" one of these the *Bathygnathus borealis*—Leidy—has left a jaw armed with formidable teeth, to tell of its existence and character.

Dreadful shakings are now felt—the earth reels and staggers—volcanic thunders are heard in the west. The western Triassic region is convulsed, lavas are poured over it throughout a length of 139 miles, forming trappean mountains throughout, among which Blomidon stands conspicuous. All becomes still and silent. From this time our boulder would seem to have had a respite from trouble for a long, long period.

Nova Scotia is at rest while Europe, Asia, and other parts of America, are sinking and rising, becoming sea bottoms and dry land, in numerous alternations, being alternately peopled by monsters of sea and land—becoming their cemetries, and then their monumental mountain elevations.

Now—

> "Like a whirlwind o'er the deep
> Comes desolation's blast."

It rains, it snows, it hails ; it snows, it rains, it hails ; it hails, it snows, it rains ; it freezes,—long, long winters,—short, short summers,—alternations interminable,—glaciers, wide spread and of enormous thickness—thundering, tearing, levelling, plowing —flowing slowly, majestically, continuously, while ages roll.

It is now the climax of desolation and destruction.—Slowly, but surely the dismal Empire declines, and after the lapse of ages, it passes away. Mountains have become plains, plains have become lake basins, and river channels. Around are *roches montonnés* and *blocs perchés*—rock surfaces polished and striated. Drift accumulations cover the sides of mountains, obscure the rocks of plains and valleys. Our boulder has now an individuality—the result of glacial action, although it is still obscured by overlying drift. The glacial *debris* becomes the soil of noble forests. These with lakes and rivers adorn the scene of former desolation. A colony of giant mammals, from the south, descendants of the pre-glacial races, roam through the forests, and recline on the lake margins. The red man appears, and possibly exterminates the *Mastodon Ohioticus* of Cape Breton, becoming the lord of the forest, with its new race of mammals—Moose, Carribou, Foxes—black and red—Bear, Wolf, Loupcervier and Wild Cat.

Acadians arrive and divide occupation with the Micmac. The Briton comes and assumes the supremacy. He takes possession of the land, builds a city, erects towns and villages, constructs roads and railways, exposes our boulder to the eye and hammer of the Geologist, who having read its history, leaves it. *Henceforth, "Requiescat in pace."*

Art. XII. The Economy of Timber and Preservation of Structures from Fire and Decay. By A. P. Reid, M. D., M. R. C. S., Edin. &c. &c. &c.

ECONOMY OF TIMBER.

This subject should receive the greatest consideration from us at present, as our lands are being rapidly cleared of their timber, and more for foreign than home use. This though helping to swell our exports, and bring financial wealth into the country, is not an unmixed benefit, for we are squandering a patrimony in a way that will soon exhaust our supplies, and demand from us an expenditure of a far higher sum for its equivalent than we have received, besides depending on a foreign or distant source for our supply. The exercise of a little judgment in this matter would be of great future avail, without being a present hindrance. Take a case in point.

The Province of Quebec has 1000 acres of valuable forest for one that we have; yet for years it had been the object of the old Canadian Government while fostering the largest lumber trade to provide for its ultimate continuance.

To guard the future as well as the present is the duty of every Government; whereas the aim of the Commercial mind is to get the largest amount of wealth in the shortest time, little heeding the prospects of the successor. Thence the conflict between the *Government* and the *individual*,—the former, having commanding power, should prevent the latter from injuring the commerce or trade of his successor.

The old Canadian Government did this by selling the land in small quantity, by the acre, and in perpetuity to intending settlers or cultivators, and by selling the timber by the square mile to those who did not want the land, but what was on it. It was sold for a term of years and by auction, so that the largest revenue was obtained while shewing no partiality to intending speculators. The object of this sale of timber, and not of land, was to favour the growth of timber, because when the largest trees are removed from a forest the smaller ones rapidly increase by growth, and the supply will not much diminish. There is an additional tax on each log that is brought down to the saw-mill. These regulations have been in force for very many years, and have worked well for all parties.

Nova Scotian legislation has not been of this conservative tendency, because but little value had been put on timber, and comparatively little had been introduced to market:—in fact our legislators did not know either the quantity or quality of Nova Scotian timber. They are now awakened to the fact, when it is all but too late; however, much can yet be done to foster this industry, and I will throw out a few suggestions.

That all owners of 1000 acres of land, and upwards, who do not carry on lumbering operations, shall be compelled to pay a tax of

—— cents for each acre yearly. This would prevent the accumulating of land in the hands of those who do nothing with it.

Where real farming is being carried on on the property, the tax to be on the excess (if any) over 1000 acres. I place the maximum at 1000 acres as it would not be oppressive on small land owners, or farmers who generally have much more land than they cultivate, more than can be cultivated owing to marsh and barrens.

That those who carry on lumbering, or saw mill operations, shall pay instead of the tax for wild land a tax of —— cents on every 25 feet of length of logs—irrespective of their diameter. Logs taken from the top part of the tree to be estimated at only half value, and half the tax.

That if in any case the sum accruing from this tax should not come up to the amount which should accrue from the land, if no operations were carried on, the difference to be made up to this amount; but if it come up to or exceed this, then no specific tax to be collected.

I would recommend the tax to be on logs, irrespective of their diameter, to the end that lumbermen should only cut the large timber, which, while preventing the degeneration of the forest, will continue the supply indefinitely.

This is needful for two reasons; first, because much of our soil at present in forest is only fit to raise forest timber; and, second, to favour shipbuilding, where a less size of timber is required, and this supply would thus be continued where saw logs had become exhausted,—and it is far more profitable for the Province to export its timber as ships than as sawed lumber.

That on logs or timber solely to be used in shipbuilding in the Province, the tax to be only one-fourth of that above referred to, or less owing to locality; the proceeds to be used in making wood roads, or improving the streams or harbors on which ships are built, to the end that this industry be assisted.

I believe it would be unwise to put any tax on lumbering operations, that would tend to diminish them, or jeopardize capital that has been thus expended; and I would suggest that after the expenses of collection have been paid, the balance should be put into a special fund to be expended in means to benefit this industry.

There are a great many small streams and rivers in Nova Scotia (I may say all of them) that it is extremely difficult to lumber on, on account of the exceedingly rough rocky bottom and the small amount of water they carry; and the Government could in no better way further the interest of the Province than to expend a sum of money yearly in blasting out rocky obstructions, and building dams and timber slides, on the most frequented streams. These improvements would save ten times their tax to the mill owners, in the large sums they now pay for log driving, besides the very large loss they sustain in logs that are scattered along the banks of the rivers, which cannot be made use of, and become much deteriorated from exposure, besides being a dead loss of about 10 to 30 per cent. of their raw material and capital for from two to three years. Practically a large per centage of logs are always so situated as not to be at command. Laws of this kind would tend to foster our lumber trade, while at the same time preventing very much waste that now exists. The crown timber lands yet to be sold should be auctioned by the square mile for 7 or 10 years for lumbering purposes.

Government should appoint an officer to superintend this department of our trade, a man thoroughly posted in lumbering and shipbuilding operations, to give reliable information and suggestions to the Government on the best method of carrying it on; such as making outlay, variation of tax on shipbuilding operations, (owing to locality,) and to attend to other duties in relation to the forest, to be again referred to.

Shipbuilding requires a great deal of timber, but a kind of little value for saw-mill purposes, and with care could be continued indefinitely. To this every attention should be paid, as the demand for wooden ships will continue to be much better than of late years, owing to the failure of iron sailing ships.

As another means of economising our timber, greater encouragement should be given to the manufacture of wooden wares, thus giving a larger home expenditure with a diminished demand on our supplies; for in addition to supplying the home demand they could be made large items of export, as now obtains in many parts of the Dominion. This variety of industry is being rapidly developed;

and though we may hail "*Saw Mill*" *Companies* as a boon, yet of far greater value is the Furniture, or Pail and Tub Factory.

There is a great deal of waste land in the Province, that with a little care and judicious inspection could be made to furnish timber either by trimming undergrowth, or by planting land that could grow pine trees even better than fir, alder, and scrub. This would have the additional advantage of making our streams perennial, instead of dry, a good part of one-half, and frozen the other part of the year, with freshets, chiefly, intervening.

Thus our climate would be kept from deteriorating, which has been proved to be the case where forests have been cleared over large areas. They modify frost, heat, rainstorms, freshets, droughts and destructive lightning discharges. We must diminish the use of wood on railways as fuel—this is now being done—and for sleepers, which must be done, by some preservative process, that will arrest their decay and in so far prevent accidents. This, however, will cure itself as it has in England, where railway sleepers of inferior wood well preserved, last for more than thirty years and still sound; with us they serve for two or three years, when they become so much decomposed as to be dangerous.

PRESERVATION OF TIMBER FROM FIRE AND DECAY.

From Decay.—Timber exposed alternately to dampness and dryness, suffers injury or absolute destruction, owing to the amount of exposure, lapse of time, and kind of wood; and various methods have been adopted to overcome this difficulty. Charring the exposed portion, was supposed to be of benefit, but it will not prevent the entrance of water and air which destroy the interior.

By steaming or boiling timber, which coagulates the albuminoid substances and washes away soluble salts, there is given a modicum of preservation which is not a commercial success for this purpose.

It is known that the resinous and odorous woods—pine, lignum-vita, cedar, &c.,—will endure the longest, and efforts have been made to add to other woods substances of this character, but the greatest difficulty has been to cause resinous and fatty substances to permeate the pores of all kinds of timber, and without which the outside protection does not much avail.

When creosote which prevents decay in all albuminoid substances was discovered in tar, the idea at once presented itself of using this means, either as crude tar from wood, or from coal, which is similar, or their products. This is by far the best method yet known to prevent decay. The tar cannot be made to permeate the wood, and when applied externally it prevents moisture from escaping, and in so far favors decay; hence its use has been abandoned. A crude, cheap, liquid creosote is obtained from tar by distillation, which can be made to permeate timber, and has remarkable preservative powers. It is now the substance most extensively used in England for this purpose.

If we could thoroughly permeate timber with creosote, tar, resin of any kind, soap, paint, or oil, we can preserve the wood thus acted on, but it is rendered more inflammable, and under any circumstances is costly.

Many metallic salts when forced into wood, preserve it from decay, and render it less inflammable. The most active agents are *Corrosive Sublimate*, Sir Wm. Burnett's *Chloride of Zinc*, *Sulphate of Copper*, *Pyrolignite of Iron* and *Phosphate of Baryta;* but their cost greatly excludes their use. *Sulphate of Iron* is cheaper, but of less value.

Common Salt has great preservative power, and is much used in shipbuilding, and might be much more used with good effect to ward off decay.

There are three ways of using these substances:

1st.—Applied to the surface which is of little use.

2nd.—A French Process of making a hole in the tree, and introducing the substance in solution. By this method before the tree dies the salt will thoroughly permeate it, and while preserving the timber, will, with some salts stain it very beautifully. The objection to this, apart from cost, is its impracticability on a large scale where lumbering is carried on.

3rd.—Placing the wood in large strong vats and forcing the solution into it. This is the most available method.

Preserving from Fire.—In this country this result would be even preferable to protection from *decay*, but the means which confers the former does the latter as well.

Chemistry has furnished us with substances that possess this property in a marked degree. *Common Alum* is very good. Filling the pores of timber with *Sulphate of Lime* or *Plaster of Paris*, by double decomposition, is also good. *Tungstate of Soda* is better than either, but its price militates against its use. Silica either alone or combined with an alkali or alkaline earth, is the best substance as yet known, and is most frequently used as Silicate of Potassa, or Soda in solution. Fuch, of Munich, Bavaria, in 1823, first made known the remarkable properties of these compounds and used them as preservatives of *stone* from decay, and of *wood* from fire and decay—and as well the best groundwork and fluid for the *Fresco* Painter. The theatre of Munich was the first edifice protected from fire and decay and ornamented also by these compounds.

Ransome in England in 1845-56, patented the use of soluble silica for the making of an artificial stone, and the preservation of stone and timber; and it is at present largely used for these purposes.

One of my objects this evening was to show the value of Silica, —injected into the pores of the wood, when united with Soda or Potassa, or decomposed afterwards by lime in solution, when so introduced, and the saturation of the timber with common salt at the same time. Or by simple application of the solution to the exterior, either alone or with clay, whiting, or Plaster of Paris, which makes a cheap and effective fire paint.

When injected into pine timber, and afterwards dried, I find it is not difficult to increase the weight 50 per cent. and confer great powers of indestructibility. It could be introduced with very great facility into telegraph poles, wharf logs, and undressed timber, by the method used for the introduction of Sulphate of Copper into telegraph poles in England, viz: by hydrostatic pressure. The fluid being elevated a number of feet above the ground, and a tube connecting it with a cup, which by means of a Caoutchouc connection is tightly secured around the large end of the log, the sap of the timber is expelled and replaced by the preservative.

I will briefly summarize the advantages due to silicating timber:

1. To prevent wet and dry rot.
2. To increase the hardness and density.

3. To preserve its elasticity.

4. To prevent shrinking and warping in drying.

5. To prevent the cracks and splits that are common in thick lumber.

6. To confer on it non-inflammability owing to the heat producing a coating of glass around each fibre, thus preventing access of air.

7. To make timber at the same time a good non-conductor of heat.

8. To prevent the joinings in frame work from giving away as is now the case, long before the timber is much weakened by the fire, which expedites the work of destruction, and endangers firemen's lives.

9. To make fireproof Mansard Roofs.

10. To have cheap and good houses, with low fire insurance rates.

11. To make stronger and more lasting wooden ships.

12. To almost prevent that awful calamity—fire at sea.

APPENDIX.

CONVERSAZIONE.

JAN. 20, 7 P. M., 1873.

A Conversazione was held in the Provincial Museum, and other apartments, and halls, of the New Provincial Building. At 8 o'clock about two hundred persons assembled in the spacious hall of the second floor, where a platform was erected and seats arranged.

At 8.15 His Excellency the Lieutenant Governor SIR HASTINGS DOYLE, the Patron of the Institute, took the Chair.

The Rev. Dr. WARREN then read an interesting paper, "On Atmospheric Air, Physically considered." The paper was illustrated by a series of beautiful and successful experiments.

Dr. A. P. REID then made instructive observations, "On Coal and its Products." This subject was well illustrated by appropriate and striking experiments.

The Rev. Dr. HONEYMAN read a paper "On Preadamite Life." The paper was illustrated by numerous specimens and diagrams.

Professor LAWSON, L. L. D., gave a short Lecture "On the Development of the Cellular tissue in Plants." The subject was well illustrated by a large series of beautiful diagrams.

His Excellency the Chairman concluded with a few felicitous observations.

The audience then proceeded to the Museum, which was brilliantly lighted.

After examining the interesting collections, His Excellency and the ladies and gentlemen adjourned to a refreshment room, where a table was spread with an ample supply of refreshments.

Having enjoyed this feast the company separated, and the Conversazione terminated about 10.30 P. M.

The Council unanimously passed a vote of thanks to the Rev. Dr. WARREN, Mrs. WARREN, and Miss CLARKE, for the admirable manner in which they had furnished the refreshment table and otherwise ministered to the enjoyment of the members of the Institute, and their friends.

D. HONEYMAN,
Secretary.

THE "CHALLENGER" SCIENTIFIC EXPEDITION. VISIT TO HALIFAX.

H. M. S. *Challenger*, Capt. Nares, arrived at Halifax on the ninth day of May last, from Bermudas. The *Challenger* is fitted out for a scientific expedition round the world, more especially with reference to an exploration of the ocean in various latitudes, and to ascertain the best situation for successful observations of the transit of Venus in 1874. She has on board Professor Wyville Thompson, of Edinburgh, Chief of the Scientists; J. Y. Buchanan, M. A.; H. M. Mosely, M. A.; John Murray, Esq.; Dr. Willemoes Von Suhm, and J. T. Wild, Esq., all distinguished in their several professions. By the kindness of the first named gentleman, who has several warm personal friends* in Halifax, formerly connected with him in scientific pursuits, and perhaps as an incentive or provocative to the study of Natural Science, every facility was afforded to the ladies and gentlemen of the City for an inspection of the ship, and a view of the submarine wonders that had up to that time been collected. These had been dredged at depths varying from 150 to 3500 fathoms—from the coasts of Portugal and Spain, the Azores, Madeira and the Canary Isles, across to the West Indies and Bermudas, and thence to Halifax, Nova Scotia. Very many took advantage of the permission to visit a ship furnished with every appliance for the great work in which she is engaged.

The magnitude of the expedition may be best estimated by the fact, that, exclusive of outfit, the annual outlay by the British Government during the time employed. is estimated at £60,000 sterling. It is to be hoped that the results will be commensurate with this lavish expenditure in the cause of science; but to say the least, the large amount of experience realized, the many points of interest settled, the correct soundings of the ocean arrived at, will be of vast national importance. The object of the expedition, it is expected, will have been completed by the autumn of 1874.

Apparata of the most perfect description that human invention has yet attained to, have been employed to promote the success of the expedition. The sounding gear is admirably efficient, both for ascertaining the extreme depth and the temperature of the ocean. Bottom has been reached at between three and four thousand fathoms, over four miles.†

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*Professor Lawson, Dalhousie College; and Rev. Dr. Honeyman, Provincial Geologist,—both Members of the Halifax Institute of Natural Science.

†At the greatest depth (3,875 fathoms) "the bottom brought up was reddish mud, containing however a considerable quantity of carbonate of lime;" at lesser depths this red mud was of a deeper colour, and extensively diffused, composing the whole matter of the collected soundings. These extreme depths were found to be not inconsistent with the existence of animal life, but not favorable to its development. The red clay is described in Dr. Thompson's notes published in "Nature," as a large and important phenomena. "In the section of the Atlantic from the Canaries to the West Indies, it occupies about 1900 miles." It is probably identical with the fertile red earth of the Bermudas, and the brick earth of Jamaica and other West India Islands, characterized by various authors as of exceptional fertility.

The temperature at various depths is correctly ascertained by a very clever thermometrical contrivance, which is difficult to be explained without the presence of the instrument itself, or a diagram in illustration thereof. Strange to say at the greatest depth the water is found to be intensely cold, which is supposed to be owing to an under stratum of cold water, perhaps a condensed polar current. May not the extreme condensation of the liquid element at such a depth be alone accountable for this degree of cold. The pressure must be enormous. Sometimes the thermometers in spite of the strong enclosure and the equable bearing of the water, are shivered into fragments. A strong metal tube was shown which had enclosed a thermometer, that in consequence of an unobserved defect when put overboard, on coming again to the surface was found to have suffered a complete collapse, the thermometer entirely destroyed. Accidents like these are inseparable from all such services, and operate as cautions to prevent their recurrence. The sinker, about 400 lbs. weight, attached to the sounding line, and calculated to carry it to any depth, resembles an Armstrong shell, bored lengthwise. It is fitted with a mechanical contrivance projecting from it about eighteen inches, a tube, which on reaching the bottom, having collected a portion of its material, is forced upward through the sinker, which then immediately becomes detached, and is left behind. Every time that deep soundings are taken the *Challenger* drops one of these as a memento of her visit. The line is recovered by the aid of a donkey engine of considerable power, which yet has sometimes to be assisted by urging the ship backward or forward, as may be expedient.

The dredging apparata is larger or smaller according to the depths. It is a strong net with an iron frame and open mouth, and drags along a trail composed of a broad swab of loose ropes, which Professor Thompson informed the party was very useful in collecting material which had been passed or loosened by the dredge itself. Every mechanical facility is taken advantage of in paying out the line, both in sounding and dredging. The reels are fastened to the waists of the ship, and the large quantity of rope wound on them attested to the great depth already reached, and to the provision for finding at the "lowest depth" "a lower deep."

It is remarkable that at the deepest soundings, animal organisms are found; zoophytes, and sponges, but nothing of a vegetable nature. At depths of four to five hundred fathoms, crustaceans of remarkable form have been dredged, new in type, without eyes, but with processes extending from the head which may make the sense of feeling very acute. Some of these of a pale pink colour when captured, were changed by the light to a yellowish white—and alcohol absorbed all colour.

After the sounding and dredging gear had been looked over, the divisions of the ship set apart for the labours of the Scientists of the exhibition, were visited—the chemical department, the photographic and natural history departments. Several of the Professors were absent in Canada; but the interest was well sustained by the kindness of Professor Wyville Thompson, who opened up the wonders of the great deep to the observation of all who chose to take pleasure in them. The blind crustaceans, zoophytes of new and remarkable species, corals, sponges, echinoderms, of varieties unknown before, were presented to the gaze of the visiters. All the forms were recent. Admirable drawings of these, taken while recently captured, were exhibited, of great interest to naturalists. The observers could only see and admire. Geology was represented by a large boulder* dredged at 300 miles south of the coast of Nova Scotia, which Dr. Honeyman, our Provincial Geologist, and Secretary of the Institute, after careful examination, recognized as a piece of Shelburne granite, carted off to sea in long past ages on an iceberg detached from the coast glacier of Nova Scotia, and deposited where it was found, to be recovered as a curiosity in the nineteenth century of the Christian era, and to help the solution of the glacial theory. There were also specimens of ocean deposits, and cretaceous collections from great depths.

To mere scientists, these rare specimens were the most interesting objects on board, and what they had especially come to see ; but there were others which judging from the admiration they excited were equally attractive. Each officer of the ship is entitled to a copy of every photograph taken in connection with the expedition.† On adjourning for a brief space to the ward-room, or as it may be styled in steamship parlance, the saloon, which is tastefully fitted up, several books of photographs, of all the remarkable scenes in the countries visited, and of the costumes and customs of the people, from the rock of Gibraltar, Lisbon, the Azores, Madeira, the Canary Isles and Bermudas, to Halifax, were politely exhibited and eagerly scanned by the ladies, and explanations afforded by the gentlemen connected with the ship, to the manifest pleasure and gratification of both parties. This concluded the visit, which had extended from 10 a. m. to between half past twelve and 1 p. m., when the party left the ship highly gratified with all they had seen and heard, and the courtesy extended to them,—and with an earnest hope that all the objects of the Expedition might be successfully accomplished, bidding God speed to the voyagers, and a happy return to their native country and friends.

W. G.

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*By some mistake this boulder, which was to have been left as a present to the Halifax Museum, as illustrating the glacial action which at one time had involved Nova Scotia in a close embrace, as it now involves Greenland, was carried away in the ship, and reposes somewhere at the entrance of the harbour—where like the Irishman's "tay-kettle," it is safe because we know where it is.

† During the stay in Halifax, the Scientists, accompanied by Dr. Honeyman, took several interesting photographs of the glacial striæ, and other geological phenomena, at Point Pleasant, and on the shore of the Tower Road.

NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE, HALIFAX, NOVA SCOTIA.

PATRON—His Honor The LIEUTENANT GOVERNOR.

COUNCIL, 1872-3.

The Anniversary Meeting of the Institute is held on the *second Wednesday* in October of every year.

The Monthly Ordinary Meetings of the Institute, when Papers are read, are held on the second Monday evening in every month, commencing in November and ending in May.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. III. 1873-74. PART IV.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 103 GRANVILLE ST.
ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.
UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.
1874.

Price, Five Shillings.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. III. PART IV.

Provincial Museum, Oct. 8th, 1873.

ANNIVERSARY MEETING.

J. M. JONES. ESQ., *President, in the Chair.*
Inter Alia.

THE following officers were elected by ballot:

COUNCIL.

President—J. BERNARD GILPIN, Esq., M. D., M. R. C. S.

Vice Presidents—J. M. JONES, Esq., F. L. S., and JAMES R. DEWOLF, Esq., M. D., L. R. C. S. E.

Secretaries—Rev. D. HONEYMAN, D. C. L., F. G. S., &c., and ANGUS ROSS, Esq.

Treasurer—W. C. SILVER, Esq.

Prof. G. LAWSON, Ph. D., L. L. D., Rev. Dr. WARREN, WM. GOSSIP, Esq., Sheriff BELL, R. MORROW, Esq., FRED. ALLISON, Esq., AUGUSTUS ALLISON, Esq.

ORDINARY MEETING, NOVEMBER 9, 1873.

DR. GILPIN, *President in the Chair.*

Inter Alia.

The President read a paper " *On the Orthagoriscus Mola, (Sun-fish) caught in Halifax Harbour.*"

Dr. HONEYMAN read a paper " *On Nova Scotian Geology.*" *Intercolonial Railway.*"

ORDINARY MEETING, DEC. 9, 1873.

DR. GILPIN, *Pres., in the Chair.*

Inter Alia.

The SECRETARY announced that the Rev. A. BROWN and W. HENRY WADDELL, who had been proposed as members at last meeting had been duly elected by the Council.

Mr. A. Ross, the Secretary, read a paper by Mr. Edwin Gilpin, M. E., "*On the Carboniferous District of St. George's Bay, Newfoundland.*"

Dr. A. P. Reid read a paper "*Agriculture allied to Chemistry.*"

The President announced that the Council had decided to hold a *Conversazione* sometime during next February.

ORDINARY MEETING, JANUARY 12, 1874.

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

Inter alia.

Dr. Lawson read a paper "*On Canadian Species of Rubi and their Geographical Distribution.*"

Mr. A. Ross read a paper "*On Dr. Girards' views on the Structure of the Fibrune of the Blood.*"

ORDINARY MEETING, MARCH 9, 1874.

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

Inter Alia.

The Secretary intimated that the following gentlemen proposed as members at the last Ordinary Meeting had been elected by the Council, viz: Messrs. C. F. Fraser, Maynard Bowman, G. R. Frith, Sawers Stirling, Robert Brunton, Rev. J. B. Uniacke.

Mr. Frederick Allison read a paper "*On Storm Signals.*"

The President read a paper "*On Seals.*"

ORDINARY MEETING, APRIL 13, 1874.

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

Inter Alia.

The Secretary intimated that the following gentlemen proposed as members at the last Ordinary Meeting had been elected by the Council: Messrs. D. H. Pitts, Aylwin Creighton, Henry Colford, G. P. Black, J. W. Marling, Jonston Hunt.

Dr. Honeyman read a paper "*On Nova Scotia Geology.*" *Cobequid Mountains, &c.*

ORDINARY MEETING, MAY 11, 1874.

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

Inter Alia.

Mr. Angns Ross, read a paper "*On Evolution.*"

Mr. Robert Morrow read a paper "*Early Notices of the Esquimaux.*"

D. Honeyman.

Secretary.

LIST OF MEMBERS.

Date of Admission.

1873.	Jan.	11.	Atkins, T. B., D. C. L., Halifax.
1869.	Feb.	15.	Allison, Augustus, Halifax.
1869.	Feb.	15.	Allison, Frederick, Halifax.
1873.	Mar.	10.	Baker, F. H., 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.	Dec.	9.	Brown, Rev. A.. Halifax.
1864.	Nov.	7.	Brown, C. E , Halifax.
1874.	Feb.	10.	Brunton, Robert, Halifax.
1872.	Nov.	11.	Cochran, B., Post Master, Halifax.
1867.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
1868.	Sep.	28.	Collins, Brenton, Halifax.
1871.	April	4.	Compton, William, Halifax.
1872.	April	12.	Costley, John, Halifax.
1863.	May	13.	Cramp, Rev. Dr., Wolfville.
1870.	Mar.	30.	Day, Forshaw, Artist, 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.
1865.	Oct.	4.	Fleming, Sandford, C.E., *Chief Engineer Dom. Railways*, Halifax.
1872.	Feb.	12.	Foster, James, Barrister-at-Law, Halifax.
1863.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., President, Halifax.
1863.	Feb.	2.	Gossip, William, Granville St., Halifax.
1863.	Jan.	26.	Haliburton, R. G., F. S. A., Halifax.
1863.	June	27.	Hill, P. C., D. C. L., Halifax.
1869.	Feb.	15.	Hind, H. Y., F. R. G. S., Windsor.
1866.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., &c., Secretary, Halifax.
1868.	Nov.	2.	Hudson, James, M. E , *Superintendent Albion Mines*, Pictou.
1872.	Feb.	5.	Hunt, Rev. A. S., *Superintendent of Education*, Halifax.
1273.	Jan.	11.	James, Alex., Barrister-at-Law, Halifax.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., Vice President, Halifax.
1866.	Feb.	1.	Kelly, John, *Deputy Chief Commissioner of Mines*, Halifax.
1864.	Mar.	7.	Lawson, Geo., Ph. D., L. L. D., *Prof. of Chem. and Natural History*, Dalhousie College.
1872.	July	5.	Lawson, Walter, C. E., Montagu Gold Mines.
1872.	May	1.	Longley, J. W., Halifax.
1873.	Mar.	10.	McDonald, Hon. James, 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.
1865.	July	15.	Nash, John D., Halifax.
1865.	Aug.	29.	Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., Lord Bishop of
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.
1868.	Dec.	29.	Roue, John, Halifax.
1869.	June	27.	Ross, Angus, SECRETARY, Halifax.
1866.	Jan.	8.	Rutherford, John, M. E., Halifax.
1864.	Mar.	7.	Silver, W. C., TREASURER, Halifax.
1868.	Nov.	25.	Sinclair, John A., Mayor, Halifax.
1872.	May	1.	Stewart, J. J., Halifax.
1874.	April	11.	Stirling, W. Sawers, Halifax.
1865.	April	20.	Smithers, George, Halifax.
1867.	Aug.	16.	Tobin, Stephen, Halifax.
1873.	Jan.	13.	Vail, Hon. W. B., *Provincial Secretary*, Halifax.
1873.	Jan.	13.	Waddell, W. Henry, Halifax.
1871.	Nov.	29.	Warren, Rev. Dr., Halifax.
1864.	May	16.	Whytal, John, Halifax.
1866.	Mar.	18.	Young, *Sir* William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
1868.	June	13.	Ford, Alfred S., London, England.
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.
1865.	Dec.	28.	Morton, Rev. John, Trinidad.
1872.	Mar.	27.	Mosely, E. T., *Barrister-at-Law*, Cape Breton.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. T., Charlottetown, Prince Edward Island.
1868.	Nov.	25.	Bethune, Rev. J. S., Ontario.
1866.	Sept.	29.	Chevalier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1871.	Nov.	1.	Cope, Rev. J. C., PRESIDENT of the 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. — Orthagoriscus Mola. Couch. Taken Halifax Harbor, Oct. 1873. By J. Bernard Gilpin, Esq., M. D., M. R. C. S.

(*Read November* 9, 1873.)

This singular oceanic fish measured, extreme length five feet six inches; breadth, half way between tip of nose and dorsal fin, three feet one inch; eye, diameter three inches, and eight inches from tip of nose; dorsal fin two feet two inches in height; anal one foot eleven inches. Color, upper part dorsal anal and candal fins and back, bluish black. Lower parts of cheeks, chin and belly soiled white. The soil being caused by small black points on the white. In reflected lights the whole white parts had a bright pearly lustre. In form orbicular, and much compressed, perhaps (though not measured) not more than ten inches in its thickest part. The back and belly both with a sharp carinated edge. Two roundish ridges commencing above and below the eye lost themselves about the middle of the body. The upper forming a kind of eye-brow, the latter making a pouting lip and cheek. The mouth was roundish, small with a feeble look, and an interrupted band of enamel served for teeth to both jaws. The nostrils were two lunated slits on each side of what resembled nasal bones rather than intermaxilliaries, and which were moveable. The iris was in a sunken orbit of three inches in diametre in death, (though no doubt in life protuding) it is silvery and half covered by a fattish membrana nictitans. The gill was also a sunken eliptic orifice below which a dark purple spongy substance showed. The pectoral fin was immediately behind the gill, orbicular small, having several radiating ridges on its substance, nearly immovable and lodged in a hollow of the body. The skin was covered with large granulations or small tubercles, pearly in a reflected light. There was no lateral line. The dorsal and anal fins both had rays in faint longitudinal marks. The part of the body behind the fins tapered gradually away, the upper half was divided into four irregular lobes, the lower part too irregular a line to classify, and contained a sharp point near the bottom. I could not detect anything approaching to fin rays edging what may be called the tail, except that the tubercles or granulations covering the whole body were larger and more numerous on the free edge.

Gunther speaks of a spine or horn on the forehead, this was wanting, though there was an approximation to it in a sharp protuberance. His spine in the tail was also only a sharp place. A faint brownish wash on the breast was the only approach to Couch's colouring, nor was there that decided black band around the tail as described and figured by Dr. DeKay. These probably are the markings of the young. I was unable to disect the whole fish from its putrid state. The liver was very large, pale yellow, and oily; the intestines simple and short, and the whole body of the fish formed by an oily cartilagenous substance about two inches thick on the belly, three or more on the back. The skin was intimately joined to this, as not to be separated by a knife; but pieces cut out and exposed to the air, slowly dissolved in oil, leaving the skin entire. This substance was beautifully white, cut with a fine pearly edge, and resembled adipocere. The whole fish was of one undulatory elastic mass. The bones as far as I could perceive were cartilagenous and cut easily with a knife. In profile the fish resembles the single screw propeller used in the service, and no doubt the motion gained by rotation, is in the fish obtained by the oscillation in opposite directions by both fins, the tail part having motion enough to steer. The fishermen relate accounts of its great velocity when attacked and roused, though usually it it is surprised basking upon its side and sleeping.

Cuvier informs us that the skeleton of this order of fishes is fibrous, yet its "tardy indurations" to use his own expression—its—all but rudimatary ribs, and absence of suture in the maxillary bones bring it exceedingly near the cartilagenous fish, and causes one to wonder how motion can be transmitted through its unwieldy undulatory elastic mass.

ART. II.—NOVA SCOTIAN GEOLOGY. INTERCOLONIAL RAILWAY. By the REV. D. HONEYMAN, D. C. L., F. G. S., *Member of the Geological Society of France, Hon. Mem. of the Geologists' Association of London, &c., Director of the Provincial Museum.*

(*Read November* 9, 1873.)

LEAVING Truro by the Intercolonial Railway, and proceeding in a northerly direction, at the distance of about half a mile, we see a fine section of an extensive gravel-bank which has done good service in ballasting the line of Railway. This bank is of *Post-pliocene formation.* The material has been largely derived from the rocks of the Cobequid Mountains lying to the north. Before reaching the DeBert Station, we pass over a long level track which shows numerous sections of the same formation, and many beautiful sections of the Triassic formation. The latter are seen in the lower parts of the cuttings, and in the openings of the various tunnels cut for the drainage. I would observe that elsewhere we have intervening between the *Post-pliocene* and *Triassic* formations, the *Pliocene Miocene*, *Eöcene*, *Cretaceous*, *Wealden*, *Oolite* and *Lias*; so that in passing at once from the Post-pliocene to the Triassic, we have an enormous *break in succession* and unrepresented *lapse of geological time.* At Folly River Bridge we still have the Triassic. The strata are seen in a magnificent section on the eastern side of the River.

In the second cutting, before reaching Londonderry Station, there is a fine section of coarse conglomerate. This is the lowest member of the Triassic series. This conglomerate was originally *shingle*, formed of the debris of pre-existing formations accumulated on the shores of the Post-carboniferous Sea.

After an obscure interval occupied by a *filling*, we have another cutting of strata of the carboniferous period. If the prevailing opinion is correct, that what is sometimes called the new red sandstone of Nova Scotia is altogether of Triassic age, we have here another *break in succession*, the Permian formation being absent. The proof of absence, however, is altogether presumptive, so that it is quite possible that the new red sandstone is partly *Permian* as well as *Triassic.*

We have now a great stretch of cuttings, showing a series of sections of sandstones, clays, grits and conglomerates. The last form a very marked feature both in extent and coarseness. The walls of conglomerate are high and threatening. They are close upon the road, masses are easily detached, obstructing the Railway Trains. The great characteristics of our carboniferous formation are not apparent in these sections—coal, gypsum and limestone are absent. The flora of the period are occasionally met with. The coarse conglomerate extends a considerable distance beyond the overhead bridge. This also is formed of shingle derived from the pre-carboniferous rocks of the Cobequid Mountains accumulated on the shores of the seas of the carboniferous period.

The last exposure of the carboniferous formation occurs in the opening of a brook tunnel. The rocks are soft black and grey shales, with concretions. Rocks are now unexposed to a distance of 700 feet, and then we have exposures of grey, metamorphic and uncrystalline rocks to a width of 2150 feet.

I believe this band to be of Middle Silurian age; others may regard it as Upper Silurian or Devonian. We have no direct evidence to settle this question, it is only by analogy that any view can be supported. General analogy is in favour of the probability that the band is of Devonian age, as the rocks immediately underlie the carboniferous. Special analogy for many years seemed to favour this view. The reasoning was thus:—On the opposite side of the Cobequid Mountains are strata which are regarded as the anticlinal equivalents of the strata in question. At Earltown, in the County of Pictou, these equivalents contain *fossils* corresponding with those of the *Typical* series in Arisaig which were considered to be Devonian by Palæontologists. Before my examination of the Londonderry Mines, part of the band of our section in 1866 (*vide Transactions of the Institute* 1866–7) our views of the age of the Arisaig series of rocks had undergone a great change. Distinguished Palæontologists on either side of the Atlantic had so correlated the fossils of the Arisaig series that the

Devonian had altogether disappeared from Arisaig, and the series became divided into Middle and Upper Silurian.

In the part of the rocks of the Londonderry Mines corresponding with the rocks exposed in our *section*, I observed a supposed lithological resemblance to the lower part of the Arisaig series, and I designated it accordingly. I supposed that a higher portion which is obscured in our section, was the Upper Arisaig. Regarding it as possible that the band might have a wider geological range than the Arisaig series, I still considered that a higher part or the part next to the Carboniferous might be Devonian. In this case the succession was regarded as *unbroken*. Now, however, as the Devonian has almost, if not altogether disappeared from Nova Scotian Geology, there is none found even to suppose its existence in the *band of our section*. I expect that the farther examination of the section through the Cobequids will show that there is every probability that the rocks under examination are of Middle Silurian age. If this is the case, we have here another *break in succession*, caused by the *absence* of the Devonian and the *obscuration* of the Upper Silurian.

The Upper Silurian of the other parts of the band has been here denuded by the seas of the Lower Carboniferous period, and overlapped by the conglomerate already described, the consolidated shingle that accumulated on the wasted Upper Silurian strata. I observed nothing very marked in these Middle Silurian (?) strata. Leaving these we enter upon another band of rocks, these are exposed in a series of beautiful sections to a width of 10,400 feet. This series of rocks consists chiefly of diorites and quartzites. The diorites are of different shades of green, and are crypto-crystalline; the quartzites are often banded. Near the commencement there is a gneissic stratum—farther on there is a bed or vein of green calcite mixed with diorite. In one of the diorite sections there is a thick vein of quartz. The lithological characteristics of this band effectually separates it from the preceeding. There is no part of the "Upper Arisaig Series," either at Arisaig or elsewhere, that shows diorites similar to those of our section. The crystalline rocks of Arisaig or what I have elsewhere named the "Lower Arisaig Series," alone exhibits diorites of similar character.

The *green calcite* of our section indicates conditions which seem to correlate the rocks of our section with the "Lower" rocks of Arisaig. The intimate connection existing between this band and the next in order on the line of Railway, points in the same direction. I have already experienced considerable difficulty in correlating the corresponding rocks in Arisaig. There was no difficulty in showing that they were older than the "Upper Arisaig Series," *i. e.* that they are older than the Middle and Upper Silurian periods. The difficulty was in ascertaining—how much older they were. I considered that I had established their lithological resemblance to the metamorphic rocks of the Quebec period of the Canadian Survey. Assuming that the Lower Silurian age of the Quebec rocks had been established, I had considered that there was little doubt that the marble and associated rocks of Arisaig were also Lower Silurian.—*Vide Trans. of Institute* 1872–3. I find however, that the age of the Quebec rocks is still a *questio vexata*, and it is maintained that they are older than the *acknowledged* Lower Silurian.

Proceeding farther along the line of Railway we have another great band, having a width of 24,000 feet, or about 4½ miles. Of this 11,500 feet is in the County of Colchester and 12,900 feet in the County of Cumberland.

The sections of rocks of this band on the I. C. R., are comparatively few and low. The rocks are almost or altogether obscured by the great gravel and sand-banks. The rocks that are seen in the sections or openings of stream-tunnels are granitoid—grey and red syenites and diorites. There are also crypto-crystalline diorites and porphyries. The crypto-crystalline diorites are not distinguishable from those of the preceding band. The transition

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NOTE.—Since I read my paper to the Institute, I have had an opportunity of examining the geological formations of New Brunswick. The resemblance existing between the great Limestone-bearing formation of St. John and the Marble-bearing formation of Nova Scotia and Cape Breton is so striking, that I have very little hesitation in regarding them as *identical.* The resemblance between the formation of St. John and that of Arisaig is even more striking than between Arisaig and Cape Breton. Profs. Hart and Bayley, and Mr. Matthews have proved satisfactorily that the New Brunswick formation is older than the Lower Silurian.

of diorite from granitoid to crypto-crystalline is readily seen in the bed and sides of a small stream which crosses the Railway at the south end of Folly Lake, and also in Rocky Brook on the north side of the same Lake.

In this brook the diorites are intersected by numerous small veins of red syenite. The red syenite, farther on, is seen to be penetrated by dark green cypto-crystalline diorite, in veins.

The sections between Jobe's and Higgin's Brooks are beautifully variegated. There are crypto-crystalline diorites of various shades of green with brown porphyries and bright red syenites. The structural aspect of these rocks is sufficiently perplexing, while they seem as a whole to be "indigenous" or metamorphic—some of the crypto-crystalline diorites and the porphyries seem to be "exotic" or igneous.

The gravel banks which obscure or partially cover the rocks of this band, seem to merit more than a passing notice. The sections on both sides of the Railway indicate the thickness and extent of the accumulations of gravel. An examination of the material, *e. g.* boulders, gravel and sand, shows that it is chiefly, if not wholly, derived from the surrounding rocks.

The extent of the accumulations, their breadth and depth, show that the waste of rocks must have been very great. The roundness of the material shows the amount of rolling to which it had been subjected, while its stratification indicates that water was the agency engaged in arranging the banks.

The formation of the material may largely belong to a period or periods anterior to the Post-pliocene, while its diminution and partial transportation southwards was the work of the agencies of the latter period.

It is possible that prior to the Post-pliocene period, Folly Lake occupied the greater part of the hollow that lies between the mountains that rise on the east and west, that it extended to the north as far as the carboniferous formation and was embanked by it, that it rose to a higher level than at present, and received the waters, with *debris*, of the streams that flow from the mountains on either side, which are now known as Wallace River and its tributaries. At this time the only outlet of the lake may have been Folly River which flows southwards and empties its waters into the Basin of Minas. The present limitation of Folly Lake, the formation of the beautiful valley on the north, the present watershed, the divergence of the waterflow, and the existence of Wallace River, may therefore be regarded as possibly Post-pliocene, while the gravel beds may be regarded as the representatives in formation and time, of these formations that occur between the Triassic and Post-pliocene, as well as the Post-pliocene itself. We thus give work and attributable results to these mountain agencies which we find now in operation and which we have no right to regard as quiescent from the Triassic to the Post-pliocene period.

Proceeding from Folly Lake we cross the Wallace River. Gradually an enchanting view opens up. On the right is the deep valley of Wallace River with the mountains rising on its eastern side and the river flowing along at their foot,—as it still opens up, it reveals a lovely panorama extending far and wide, which excites the admiration of all travellers. We have reached the apparent extremity of this granitoid band. Its last outcrop is seen in a small nameless brook on the left side of the road. I have already observed that this is 12,900 feet from the county line.

Since leaving Truro we have made an enormous *descent*, geologically, while topographically we have *ascended* 600 feet above the sea level, the height of Folly Lake. Since leaving Folly Lake we have descended topographically 124-45 feet, our position being now 485-55 feet above the sea level. We are now on the northern side of the Anticlinal. As we proceed farther we *descend* topographically and *ascend* geologically.

The band succeeding has a *width* of 8,300 feet. Its first exposure is in the opening of the Tunnel of Smith's Brook. The rock is crypto-crystalline diorite. The finest exposure is in the Railway cutting to the north of the brook. This cutting exposes equal sections of rocks on either side of the line, their maximum height along the road is 83 feet; the minumum 56 feet. The variety and beauty exhibited by the walls are very striking there are magnificent slickensides, the glistening of the rocks make them brilliant in the sunshine. There are red Porphyries, crypto-crystalline diorites of various shades of green—one band of diorite shows occasionally crystals of red feldspar, it is Porphyritic. There are also banded jaspideous rocks. The rocks seem to have a dip of 48° N. 30 E. The jaspideous rocks and the absence of granitoid rocks make me separate this band from the preceding, just as I separated the one preceding it on account of its quartzites and want of granitoid rocks. The diorites of either band and the porphyries of Smith's Cutting might readily be regarded as the associates of the granitoid rocks and a part of the central band.

Proceeding still further we observe on the side of the Railway outcrops of purple coloured grits, some of these having abundance of crystals of yellow felspar were for some time mistaken for porphyries. There are also massive boulders of very hard purple conglomerate, with inclosed pebbles of scarlet jasper. There are also outcrops of purple jaspideous rocks and crystalline diorites. Besides these there are other rocks which it is difficult to characterize. At the Wentworth Station there is an obscure interval which is probably the approximate position of a conglomerate of rather peculiar character. A little below the Station on the road to Wentworth are seen large and small boulders of this conglomerate. These are composed of diorites and jasper pebbles, firmly cemented together. Some of the diorite pebbles are amygdaloidal and amygdaloid — porphyritic. The *amygdals* are calcite and the crystals red felspar. I have seen nothing like this conglomerate in any other part of Nova Scotia. The whole of this band of rocks must have been formed under strange conditions. In many respects it seems to resemble the Cambrian Formation of H. M. Geological Survey of Great Britain. *Vide Ramsay's Geology of North Wales.* At a farther distance of 100 feet north of the Wentworth Station there is a remarkable cutting of rocks. This cutting is 1100 feet in length. The walls on either side of the track are equal, their maximum height is 28 feet. I give the section with approximate measurements.

Obscure.	*Feet.*
1. Dark green Crypto-crystalline Diorite................	30
2. Black soft Shale................................	20
3. Diorites with shale parting......................	8

4.	Black Shale	56
5.	Diorites with Pyrites and Crystals of whitish Felspar	16
6.	Black Slates and Shales, very pyritous, cleavage and jointed, having abundance of Fossils, dip 45° 15′ N, 5 E	40
7.	Diorite—pyritous	24
8.	Black Slates and Shales with joints—of dip 41° N. 5 W	100
9.	Diorite pyritous	14
10.	Shale	140
11.	Diorite	60
12.	Shale	6
13.	Diorite	30
14.	Shale	10
	Vertical thickness of the whole	615

It will be observed that the Lithology of this section is singular from its alternation of very hard and very soft rocks. The familiar diorite of the former sections occur no fewer than seven times, but instead of the quartzites, granitoid rocks, porphyries, jaspideous rocks and conglomerates, we have substituted very soft slates and shales. The dip in the other bands described was either obscure or uncertain. Here the dip of the slates and shales is unmistakable and the slate beds are divided into blocks by cleavage joints, occurring at right angles to the dip. The occurrence of Diorite, No. 7, between slates 6 and 8, with so little variation of the dip together with the conformability of the other diorites, the softness of the shales and other considerations to which I shall afterwards allude, induce me to believe that the beds of diorite were contemporaneous in formation with the slates and shales of the section.

I would here observe in reference to this *form* of diorite that I have not elsewhere found it in Nova Scotia associated with uncrystalline rocks. The only other instance of its occurrence is at Arisaig, in the "Lower Arisaig Series," where it is seen associated with granitoid diorites, hornblende rock, limestone, ophites and ophiocalcites. Here as in the central band of our section of the Intercolonial Railway, the crypto-crystalline passes gradually into the granitoid diorite. *Vide Transactions* 1872–73. I have not found it in connection with the "Upper Arisaig Series."

In slates and shales, No. 6, I found abundance of fossils. The prevalence of *Lingula* and *Orthis testudinaria* led me at first to think that I had found a formation corresponding in age with my lingula beds in the County of Pictou, or the B. of my Upper Arisaig Series. The farther discovery of *Graptolites*, led me to suppose that we had the equivalent of the graptolite shales of Doctor's Brook, Arisaig Township, or the lowest part of B. of Arisaig, or the base of the Lower Clinton. One difficulty in the way of this correlation, arises from the absence of A. Arisaig or the Mayhill sandstone equivalent. Wherever the lower members of the Upper Arisaig Series are found in Eastern Nova Scotia this is always present. Supposing, however, that this case may be exceptional. With a few exceptions the fauna are different from the familiar forms of the Arisaig series. The exceptions are *Calymene Blumenbachii*, *Terebratula affinis*, *Strophomena depressa*. These are Lower, Middle and Upper Silurian forms and indicate no particular Silurian horizon. *Orthis testudinaria* is a form of very frequent occurrence occurs in the B' or Upper Clinton of Arisaig, but it is also a Lower Silurian form. Diprionidean forms of graptolites, *e. g. Climacograpsus* occur in the Doctor's Brook shales, or the base of B. of Arisaig, Lower Clinton. The existence of *Climacograpsus* at Doctor's Brook was a palæontological difficulty, in the way of correlating the containing strata. Prof. James Hall in his work, "On the Graptolites of the Quebec Group," makes the Hudson River group the Upper limit of this form, Vide Table. This led me in my paper "On the Geology of Antigonish County," to regard B of Arisaig as of Hudson River age, and A as Utica State.

Subsequently, however, I came to regard the graptolites of Doctor's Brook as a colony from the Hudson River—Lower Silurian. I was led to this conclusion when I made a systematic and

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NOTE.—This form of diorite occurs frequently in the Huronian rocks of St. John, N. B., and also associated with the Lower Silurian slates at the end of the Mispec Road near the old Episcopal Cemetery.

thorough examination of Arisaig in the summer of 1868. I then extended the graptolite and lingula shales of Doctor's Brook to the cove south of Arisaig Pier. Here I found the shales having a rich and varied fauna. They were in close contact with the slates and shales, whose characteristic fossil is the *Graptolithus clintonensis.* I found that while the two setts of strata were lithologically distinct, the graptolithus clintonensis passed downwards into the lower shales, and consequently I distinguished the latter B as Lower Clinton, the former B' as Upper Clinton, and so regarded the graptolites of Doctor's Brook as a colony. I regard the *climacograpsus* of the slates of the Intercolonial Railway as characteristic as the associated *Lingulae* are forms different from those of the Upper Arisaig series. They strikingly resemble Trenton Limestone and Hudson River forms. The other fauna are all different from those of Arisaig, and are new to Nova Scotian Palæontology. I therefore distinguish this as the "Wentworth Group," and regard the formation as approximately Hudson River, U. S., or Bala, England. The position that I assign the group in Nova Scotian Geology, is between the Upper and Lower Arisaig series, *i. e.* between the fossiliferous and crystalline.

The Wentworth fauna of my collection are *Orthoceras* 2 sp. *Cyclonema*, *Avicula*, *Cyrtodonta*, *Modiolopsis*, *Strophomena*, *Leptaena*, *Chonetes*, *Camerella*, *Rhynchonella*, *Atrypa*, *Lingulae Discinæ*, *Cornulites*, *Tentaculites*, *Asaphus*, *Calymene*, *Dalmanites*, *Crinoideæ*, *Graptolithus*, *Climacograpsus*.

The *Graptolites*, *Linguloe* and *Discinae* are beautifully preserved, many of the others have been *pyritized*, and the remainder are in the form of casts.

Preceding on the line of Railway we have, after the Wentworth section an obscure interval between Little Whetstone Brook and Big Whetstone Brook, and then two sections of metamorphic rocks having a width of 2000 feet.

NOTE.—Considering that rocks of the Intercolonial Railway have a greater resemblance to those of Saint John Co., N. B. than to the eastern part of Nova Scotia, with the exception of "Lower Arisaig," I am disposed to ally this part of the Cobequids with Saint John, and to regard the Wentworth slates and their *fauna* as the successors of the Saint John slates and their *Primordial fauna*

These rocks are exposed in the upper and lower openings of the Tunnel of Big Whetstone Brook; in the upper the rocks are brownish slates, in the lower they are massive diorites, similar to these already met with. In the beginning of the next cutting are slates with a bed of diorite, associated with a brown porphyry. These slates produced a large *lingula* of the *Middle Silurian* type,—the strata have a high southerly dip, being apparently synclinal to the "Wentworth" group. The stratification is obscure. The bed of diorite and porphyry is assumed as conforming with the possible dip of strata. There is an apparent physical division between the two, or a depression which extends into the mountains. Big Whetstone Brook flows through it. At the end of the cutting is another dark brown *porhpyritic rock.* After an obscure interval there is another cutting, having at its commencement a thick bed of green diorite and then slates, without any farther occurrence of crystalline rocks.

After another obscure interval we come to a cutting having on either side sections of lower carboniferous conglomerate with overlying sandstones. The conglomerate is largely composed of boulders of the preceeding crystalline rocks. One boulder of porphyry embedded, was remarkable on account of its size—its weight was estimated at two or three hundred pounds. In the overlying sandstones were found embedded several masses of red syenite. One of these which we detached was very large—at least two hundred pounds weight. It was surrounded by carboniferous *flora*, compressed *calamites* and *cordaites*, some of these remained *adhering* to the syenite (vide specimens in the Provincial Museum.) These syenites must have lain on sandy flats surrounded with vegetation, both having become simultaneously embedded in the sand, and intimately associated. These are the earliest *flora* of the Cumberland Coal Field. The nearest red syenite rocks are two miles distant. These *facts* were noted as remarkable.

Descending Big Whetstone Brook at the junction of the Lower and Middle Silurian, we pass from the massive diorites in the lower opening of the tunnel, and then through slates, and then we come to *grits* of Lower Carboniferous age—succeeding these are sandstones. In these sandstones I found abundance of *rain prints*, *rill marks*, *casts of ferns* and *reptilian foot prints* in abundance. These foot prints are of varying shapes and sizes, some of them are truly formidable. Some of the reptiles had walked over the rain-pitted mud in a soft state and left deep impressions: others had walked over it when less soft and left impressions less deep; others had traversed the mud when it was netted with shrinkage cracks and left faint impressions. One had set his foot on a fern leaf which lay in his path, another between two long series of right and left steps has left a continuous tail-trail. These are to be found in the Museum.

It was fortunate that the Intercolonial Railway took its present course after passing Smith's Brook. To the right, at the distance of half a mile, we find at a bridge of Wallace River, that the lower carboniferous conglomerate lies directly on the continuation of the rocks of Smith's Cutting, so that in this direction the conglomerate, diorites, fossiliferous shales, &c. have all been denuded by the lower carboniferous seas, and covered by their shingle (conglomerates.)

To the (left) west, at a distance of three miles, we find that the work of destruction has been more complete, as the lower carboniferous conglomerate lies directly on the syenite. The interesting pre-carboniferous rocks of the northern part of the Intercolonial Railway in the Cobequids, is only a remnant left to show what once existed, and to reveal facts in geological history altogether at variance with our hitherto received opinions of the geological structure of the Cobequid Mountains.

In my examination of this and other sections of the Cobequid Mountains, I was accompanied by Mr. Andrew Jack, and occasionally by Mr. Frank West and Mr. Robie Cogswell. These gentlemen added many interesting fossils to our Wentworth collection.

I am very much indebted to K. S, Archibald, Esq., C. E., for the use of the Intercolonial Railway working plans and sections, by which I am enabled to give accurate measurements of the various groups of rocks and sections.

ART. III.—SKETCH OF THE CARBONIFEROUS DISTRICT OF ST. GEORGE'S BAY, NEWFOUNDLAND. BY EDWIN GILPIN, M. A., F. G. S., *Member of the Newcastle Institute Mining Engineers.*

(*Read December* 9, 1873.)

THE south shore of Newfoundland, from Isle Aux Morts to Cape Ray, is composed of dark slates and quartzites, pitching at a heavy angle to the south, and much disturbed by veins and masses of coarse feltspathic granite. The metamorphism has been very great, and the action violent, the intrusive rock being often twisted into curious knots containing fragments of the resisting slates. I was unable to form any idea of the age of these strata, but they closely resemble our Lower Silurian rocks in the neighbourhood of their trap.

Since my return, a small crystal was given to me as coming from Port au Basque. It is of a bluish colour, containing phosphorous and a large proportion of iron; it hardly answered the description of Vivianite as given by Dana, but seems to correspond more closely with the mineral Triphyline. Any of the phosphates occurring here in sufficient quantity would be of great economic value, as the locality is one of the most accessible in Newfoundland.

The long narrow reefs and islands that skirt the shore, forming the ports of Channel and Deadman's Harbour, have been worn out by the action of the waves upon the beds whose strike is generally parallel to the line of the coast. About six miles inland from Port au Basque is a high range of hills, forming a spur of the great interior plateau of the island, and running parallel to the shore until it terminates in Cape Ray. The land rises gradually to their foot in small hills, many of which are composed of granite. The width of the hill range is about ten miles at this point, but it already exhibits the distinctive features of the plateau, being covered with swamps and spruce underwood draining into large ponds and lakes. The rivers rising in this water shed, flow in all directions toward the sea; leaving the highlands in a series of cascades and rapids, their windings among the boulder strown valleys afford capital breeding ground for the salmon so abundant on this shore. At Cape Ray the lowland diminishes in width to three miles. And in front of the Cape supports three large conical hills called the Sugar loaves. Their bare granitic flanks, thrown into relief by the dark background, form fitting portals to the great silurian plain of the St. Lawrence. Behind rises the precipitous front of Cape Ray, its dark slates relieved by the patches of perennial snow in the deep ravines. Between the highland and the most northerly of the Sugar loaves are traces of a great fault, which Professor Murray of the Geological Survey claims to have traced across the island.

As we pass to the Cape we see the dark line of the plateau trending away inland to the eastward, till its scarpement grows dim and is lost to the eye beyond the head of Bay St. George.

The next highland that we notice is Cape Auguille, an enormous ridge of intrusive rock running obliquely toward the plateau, but sinking beneath the carboniferous strata before reaching the Codroy River. Between these two Capes is the carboniferous district of the Codroy Valley, triangular in shape, its base resting on the sea, and its apex pointing to the east. The measures on the shore dip inland, and consist of red sandstones and shales with at least two large deposits of gypsum. Were the dip of the measures undisturbed we would expect to find the productive coal strata at no great distance from the shore, but the gradual approach of the boundary rocks continually brings up lower beds. This accounts for the large development of Lower Carboniferous measures exposed in following the Codroy River to the eastward.

Two small seams of coal with beds of black shale are said to crop near its source, but no systematic exploration has yet been made. From the facts observed on the Barasois Rivers, it is possible however, that they may indicate the commencement of an area of productive measures.

On rounding Cape Auguille we are at the mouth of St. George's Bay, a magnificent sheet of water 60 miles long, and 40 wide at its entrance. We again meet the carboniferous strata affording a beautiful section at their point of junction with the older rocks of the Cape. The dark slates pitching steeply to the north, are overlaid by the unconformable carboniferous, whose dip is to the north-east, but at an easy angle. In the cliff close to the point of contact are seen signs of an upheaval of unknown extent; a little further to the north is another of about fifty feet, followed by three more with from twenty to forty feet of dislocation. The strata are red and brown sandstones with beds of black shale; the force of the upthrow has carried the latter through the lighter coloured stones, so that the lines of fault are marked on the cliff in narrow gores of black pulverized shale.

From this point to the head of the Bay are frequent exposures of the Lower Carboniferous, in many places disturbed, but with a general dip to the south-east. As the strike of the beds approaches to a parallelism with the shore, measures are made slowly, so much so that opposite St. George's Town, a distance of fifty miles, we still find beds of conglomerate, whose warm color recalls their counterparts when of triassic age. A clear idea of the measures of the district can be obtained by ascending the Barasois River, which pursues a general south-east course towards the interior. At its mouth is a large cliff of red sandstone, succeeded by their limestones and conglomerates; about three miles from salt-water the river has cut its way through an immense bed of gypsum and red marl. Although identification is rendered impossible owing to distance and intervening dislocations, it is probable these deposits are on the same horizon as those of the Codroy Valley. The gypsum crops again five miles to the westward and is exposed on Fissels River ten miles east of this point. A line drawn from the gypsum of Kippens Brook, north side of the Bay, to the mouth of the Codroy River follows closely the line of crop of these beds and furnishes an important key to the whole district. Still ascending the River we pass beds of Conglomerate, some of which appear to be repeated by faults. In certain of the beds are found large fragments of magnetic iron ore, plainly derivable from the great deposit of black oxide in the older rocks. Gradually they pass into finer grits with beds of sandstone and bluish fireclay. About eight miles from the shore is the crop of a small coal seam in the vertical measures of a fault. The next four miles is through a series of anticlinals with signs of many dislocations, pursuing a general north-east and south-west course, and occasional crops of very small coal seams from two to ten inches thick, with underclays bearing stigmaria. The first regular coal seam is now met, its thickness is two feet nine inches, with a band of ironstone balls in the roof, as it is between sandstones there is not much probability of any increase in thickness. The measures are lying at a very heavy angle, with a strike approaching north and south. Higher up the measures become flatter with another seam three feet thick, then follow coarse gritty sandstones for about two miles.

Beyond this point the current of the river slackens, the banks become low and afford no exposures. Thickets of alder and long grass shelter the wild geese which at the time of my visit were breeding in great numbers. We are now at the foot of the plateau and find the river leaping in a cascade from the side of the Silurian mountains.

Climbing the nearest hill we endeavour to trace the course of the river and imagine its source far up in the Table Land. As we gaze into the unknown interior, range after range of hills rise up before us; their flanks, covered with spruce underwood, and bare storm swept summits looking down upon the little lakes, each set in a soft green swamp, over which the Carriboo can scarce pick his way. The dark bitter waters unmoved by any wind, reflect only the wild fowl and clear cut hill tops. Such is the source of nearly all the Newfoundland rivers. In spring they pour from the snow fed swamps an impassable torrent, and dwindle away in summer to a mere thread.

Retracing our steps to the sea coast we find a similar section exposed on Fissel's River, ten miles to the eastward. Between this point and St. George town are large hills of drift, sometimes over one hundred feet high, and pointing towards the gap in the hills through which the Main River flows. South of the town about six miles from the shore, is a spur of the older rocks containing an immense deposit of *Magnetite*, identical in appearance with the fragments mentioned as found in the conglomerate. The specimen of Magnetite in the Museum, given by Mr. Bishop, is from this locality.

The prevailing indraft of westerly wind, and the contour of the Bay causing a tide to flow in on one side and out on the other, have deposited huge sand banks at the mouth of the Main River. In many places these banks show beds of black sand, varying from one to thirty inches; doubtless research would expose thicker beds in localities not now subjected to the action of water.

The origin of these iron sand ores is to be found in the crystalline rocks, from the disintegration of which they have been derived. The action of the waves, by virtue of the greater specific gravity of these sands, effects a process of concentration, so that considerable layers of black sand are often found on shores exposed to wind and tide. The composition of these black sands vary according to locality, but as found on the St. Lawrence consists of magnetic oxide of iron, with a large mixture of titanic iron ore, and more or less of garnet. The purest specimens hold about forty-five per cent. of black oxide.

Indian Head is a mass of trap forming the south side of the coal field of that name. A visit to the measures exposed on the Indian Brook was impracticable, but on the authority of Prof. A. Murray, Chief of the Geological Survey, undoubted coal measures are found there. A small seam is known to crop near the shore, but the coal is of very inferior quality, hard and full of stone.

Five miles to the westward at the mouth of Kippens Brook, is one of the most magnificent exposures of gypsum in the world. The brook flowing obliquely across the crop of the bed, has bared a great cliff, four hundred yards long and one hundred feet high, of soft white gypsum of the finest quality. Parts of the cliff contain alabaster of unusual clearness. The specimens sent from this locality to Boston and Philadelphia were much admired.

Following the brook upwards, the measures which at the gypsum pitch to the east, gradually bend round to the south, and we find ourselves in the bed of a synclinal which has been frequently shifted to and fro by upheavals. The measures consisting of sandstones and shales with beds of grit, rise towards the hills on each side. After a few miles the measures become level and are connected with those of Indian Brook. There is a large tract of level land extending for several miles beyond this point, as yet unexplored. Here search should be made for coal, as the measures already passed are evidently those of the horizon underlying the productive strata.

The next object of interest is the peninsula of Port a Port, forming the north side of the bay.

From Cape St. George to the Gravels the south shore presents an almost unbroken wall of limestone, dipping to the north at an easy angle in a series of lateral undulations, varying in length from a quarter to two-thirds of a mile. The profile of the shore on the south side is a perfect contrast to that of East and West Bays. Long continued action of waves on rocks dipping inland does not make a shelving beach, as the undermined cliff falls into the sea, and the outline of the shore becomes straight.

Crossing to East Bay we find the limestones still dipping to the north, and the action of the sea against their pitch has made long beaches cut into numberless small coves. Part of the limestone has been worn away more slowly, and gives the shore a very strange appearance. At first one would imagine the massive ruins of some colossal building had been piled along the beach. At one point we see a number of detached pillars standing at intervals of almost mathematical regularity; sometimes capped with a round ball of the same material, or squared as if they were the lower part of some huge portal. Then come great rounded blocks piled one above the other, forming a perforated mass through which a carriage could be driven. The solid background of the cliff has been cut into circular semi-detached columns, marking a future row of these sculpturers of the sea. Such is the appearance of the shore for miles, every change of position bringing out fresh and stranger forms.

In one place there are two large caves hollowed out just above the level of low water. We explored the larger of the two. After following a narrow low gallery of over two hundred feet, we found ourselves in a spacious vault, worn perfectly smooth by the water, and glistening in the light of our torches. Another gallery led further into the cliff but could not be followed more than a few yards, as the roof grew too low to allow our passage. The other cave is about thirty yards long, very low in places, and terminating in a similar vault.

Close to the cave a large deposit of barytes is exposed on the beach. The vein is several feet wide, running north and south; its quality is excellent, being compact and free from impurity. The whole of this district is crossed by small veins of crystallised calc spar, sometimes containing galena; they are of workable size only at one place, in East Bay, where a mine has been opened and vigorous operations pushed forward. The vein is exposed in a land locked cove, worn out by the action of the sea on the soft bed rock. The foot wall of the richest portion of the vein, yielding about fifteen per cent of lead, has been defined. The total width of the plumbiferous rock is over twenty feet. The ore is the common sulphuret of lead, with copper pyrites, calc and fluorspar. I was informed that the per centage of silver present was inconsiderable. The limestones on the east side of the cove contain a beautiful shell bed, affording the characteristic Lower Carboniferous fossils, and near this is an argillaceous sandstone filled with indistinct fragments of broken plants.

On the point of land separating East and West Bays are found abundant indications of petroleum; it oozes from crevices in the rock, and can be secured in considerable quantities. No attempt has yet been made to trace it to its source.

In this connection, a notice of the position of the Pennsylvania Petroleum may be interesting. Beneath the conglomerate are a series of thin bedded sandstones and shales, the latter often an olive green color. These may be readily recognized as belonging to the Chemung and Portage groups of the New York Geologists, and known in Ohio as the Waverley series. Under this is a bed of bituminous shale from two hundred to three hundred feet thick, called in New York the Hamilton shale, and known in Ohio as the black slate. Much oil is found in this bed. Dr. J. S. Newberry considers that the indications of oil in higher measures are derived from this reservoir by percolation through the more porous strata.

I have glanced over the more prominent geological features of the Bay, they are of unusual interest both to the geologist and miner. Almost the whole series of the carboniferous measures are exposed, and can be studied under every condition of disturbance. The lowest of the measures passed over are those of Long Point, then come the East Bay limestones. The exposures from Cape Auguille to the Barasois Rivers fill the interval between the Gravels and Kippens Brook. The gypsums of Codroy, Barasois and Kippens form an important horizon. Above this come the sections of the rivers and Mr. Murray's coal fields of Indian Brook, which may be represented by the imperfect exposures of coal measures fourteen miles from the mouth of the Barasois River.

Although the deposits of coal have not yet equalled the expectations of investigators, the presence of iron and lead in unusually large deposits, together with the indications of other minerals, marks this Bay as the future scene of extensive mining operations. The summer is clear of fog, and the winter ice lasts only from January to April, so that St. George's Bay has a material advantage over many places lying further to the south.

Art. IV.—On Canadian Species of Rubi and their Geographical Distribution. By George Lawson, Ph. D., LL. D., *Dalhousie College.*

(*Read January* 12, 1874.)

(ABSTRACT.)

Rubus was described as a genus of plants belonging to the natural order *Rosaceæ*, an order which embraces about a thousand species and a countless number of varieties of artificial origin. An unusually large number of these plants are natives of temperate countries in the northern hemisphere. *Rosaceæ* has furnished our gardens with numerous ornamental plants, such as the hawthorns, pyrus, roses, sweet briars, almonds, spiræas, potentillas, amelanchier, geums, &c., whilst our orchards are indebted to the order for the varieties of apple and pear, cherry, plum, peach, quince, and many others. To the botanist some groups of the *Rosaceæ* have a specially vexing interest, on account of their proneness

to vary in the wild state, and the consequent difficulty of determining what are really distinct permanent species as distinguished from varieties. This is particularly the case with regard to the European *Rubi fruticosi*, many of the long recognized species of which are so closely related that some of our best botanists now rank upwards of twenty forms, too well marked and too constant to be mere varieties, as so many "sub-species," under the specific type of *Rubus fruticosus*. The European Raspberry, R. Idæus, stands out from them all, a solitary, isolated species, that has no intimate relation to any of them, and no tendency to vary in their direction. In fact the relatives and derivatives of this species are to be sought for out of Europe. It is known to be spread over the whole north of Europe and Asia, even so far as to Mandschuria and Japan, but to be absent from the American Continent. Here we have its representative *so called species*, R. strigosus, our common raspberry, while this and other Canadian species have their representatives in Eastern Asia. As the result of a most elaborate investigation, Mr. F. W. C. Areschoug has arrived at the conclusion that the European raspberry, as well as the North American forms most closely related to it, grew primitively in Japan and adjacent countries. (*Botaniska Notiser*, 1872, *and Journal of Botany*, 1873.)

The remarkable similarity between the flora of Eastern North America and that of Eastern North Asia, has been prominently brought under notice by Professor Asa Gray long before its true significence, or the questions which it suggested were fully appreciated by botanists. His views are that our present vegetation in Eastern America, or its proximate ancestry, occupied the arctic or sub-arctic regions in Pliocene times; that plants of the same stocks and kindred, forming a nearly uniform flora round the arctic zone, (as uniform perhaps as our present arctic flora), made their forced migration southward upon widely different longitudes, and receded more or less as the climate grew warmer, and different associations of plants thus established themselves in regions suited to them, but not in any other. In the light of Professor Gray's theory, and the special results obtained by Mr. Areschoug, Professor Lawson described in detail the various species of Rubus inhabiting the

Dominion, tracing their range on both sides of the Continent, and also in Asia and Europe, and pointing out the structural modifications which they presented. He regarded R. occidentalis, R. intermedius, R. Idæus, with Leesii and its other European forms, and R. strigosus, as well as all their sub-species or subordinate forms, as forms of one specific type, distinct form, and not necessarily related in origin, but only in some points of structure, to the other members of Areschoug's North American type.

Details were given to show that R. villosus was probably a Southern species, whilst Canadensis was more Northern. R. triflorus is more intimately related to the European saxatilis than is generally believed by botanists. R flaccidus appears, from its observed constancy in Nova Scotia, to be entitled to rank as a sub-species of R. hispidus, which seems to have been originally a mountain species, rather than an arctic one.

R. Chamæmorus, although an Arctic plant, and, in Europe, confined to the mouutains of the North, abounds at the sea level in Nova Scotia, producing the berries sold in the Markets under the name of "Bake Apple." It was stated that the present range of many so called Arctic plants in Europe could not be regarded as coincident with their primeval range. A long period of civilization had driven out many swamp plants, which now only exist in the sheltered recesses of the Northern Mountains, just as, year by year, on the American Continent, the same or similar species are slowly meeting with the same fate ;—these are the outpost remnants that speak of a wider and more Southern distribution in former times.

The effects of forest fires, of animal agencies, of railways, of lumbering, mining and agricultural operations, in extending the distribution of some of Rubi, and circumscribing that of others, were also referred to.

Specimens of the Canadian species were shown and described, also specimens from various parts of Europe and Asia for comparison, showing the gradations from the thickly felted species of tropical India to the delicate membranous leaves of those growing in the Arctic regions and on the Scandinavian Mountains.

ART. V.—THE FIBRIN OF THE BLOOD—ITS CONSTITUTION AND FUNCTIONS AS EXPLAINED BY DR. CHARLES GIRARD OF PARIS. BY A. ROSS, ESQ.,

(*Read March* 9, 1874.)

ACCORDING to our text books of Anatomy and Physiology, the fibrin of the blood is a "proximate principle," structureless and held in solution by the serum; its uses and real nature not definitely known.

I desire to call attention to its true structure and functions as explained by Dr. Charles Girard of Paris.*

When blood is drawn and allowed to cool rapidly, it forms a clot, the fibrin separating from the serum, and forming a semi-fluid, having no definite structure, but seeming somewhat thready (hence its name), and enclosing the red and the white corpuscles. Dr. Girard suspecting the true nature of fibrin, made an experiment for the purpose of determining it with very remarkable and valuable results. I give a free translation of his own words.

"I took a full grown deer, in perfect health, and opened a vein and artery so as to effect a gradual extinction of life from loss of blood. The heart in these circumstances lives longer than the other organs; its movements, in losing their intensity, permit a small quantity of blood to remain in its cavities under the gradually decreasing influence of life. The result is that the fibrin there continues distended with serum, and when placed under the microscope, without having lost its warmth, the cellular nature of the fibrin becomes as distinct as that of the vitellus. The cells are seen to be little transparent globules, having opaque points or nuclei in their centres."

I now proceed to give a resumè of his views of the origin and morphological relationships of fibrin.

Every organic tissue is composed of cells variously modified.

The lowest form of mature organic life, and the earliest form of each individual organism is equally a single cell, and the further

* "La Vie au point du vue phisique," and "Principes de Biologie appliques a la Medicine."

development of any organism consists in the multiplication and addition of cells and their modification into the several tissues, while nutrition consists simply in the replacing the worn out cells by new ones, and the assimulation of these with the tissue into which they have been incorporated. Cells are of two kinds—primordial and derived—the primordial being the result of the union of oil albumen combining according to their reciprocal affinities, and the derived resulting from the development of the nucleus which appear soon after their formation.

The experiments* of Ascherson shew that the simple contact of oil and albumen at the ordinary temperature of the blood of animals, immediately results in the formation of cells, of which the albumen forms the envelope, and the oil the contents. Cells so formed, artificially, resemble so closely, as to seem identical with, the primordial cells produced within the animal, but pass through none of those phases of development which characterize the latter.

Researches on the formation of the egg in the various classes of the animal kingdom, have shewn that there is a time in its history when it cannot be distinguished from the ordinary cells constituting the organic tissues. It however undergoes a special development. Nuclei appear in its interior, and are developed into true cells which similarly develop within them new cells. When the third generation of cells has appeared, the first cell envelope disappears, setting free its contents. And this process goes on until the mass of cells which constitutes the vitellus or yolk of the egg is produced. It is well known that the white of the egg with which we are familiar in the eggs of fowl is merely a supply of albumen provided for the nourishment of the chick, and like the calcareous covering which in such eggs constitutes the final envelope, is not a necessary adjunct to an egg. In the white of the egg, when it exists, "floating cells" are found, which have become detached from the vitellus, and consequently undergo an abnormal development. Similar "floating cells" are found in the vitellus during the progress of segmentation.

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* Archives of Anatomy, Physiology, and Medicines, edited by J. Muler, Berlin, 1840, p. 44.

The pulp resulting from the digestion of food is *chyme*. That portion of the chyme which is taken up by the lacteals is called *chyle*—a fatty liquid. It meets the lymph—an albumenous liquid collected from all parts of the body by the lymphatic system before they are together carried into the venous system; and it is at this first contact of the two liquids that the primordial cells are formed; but such cells may also be found in the chyle alone, inasmuch as it also contains albumenoid substances.

Passing through the lungs the cells assume the red color which is characteristic of arterial blood, and their nuclei are rapidly developed into new cells, which in turn give birth to other cells, which becoming freed constitute the fibrin of the blood, or protein cells, the common basis of all organic structures. Such of these cells as are not incorporated into the tissues within a certain period, undergo an abnormal development and then constitute the white corpuscles of the blood, which are morphologically identical with the various epithelial cells, as also with the "floating cells" of the egg and embryo. The cells composing the vitellus are true protein cells like those constituting the fibrin of the blood, and similarly derived from a primordial or parent cell.

In polyps, and the inferior orders of radiates, mollusks and crustaceans, the nourishing fluid circulates in the form of *chyme;* in the higher orders of these sub-kingdoms in the form of *chyle;* and it is only in the vertebrates that blood properly so called is found. Blood consists of a liquor composed of albumen and water, containing various salts in solution, and in this liquid, floating as free cells, the protein or fibrin cells so minute as to require to be magnified 900 diameters, in order to be distinctly visible; the red cells or corpuscles, much larger in size and so numerous as to give color to the mass, and the white corpuscles less in size than the red, and comparatively very few in number. When the blood gives up its protein cells to the tissues, the albumen and water remain, and this last with its salts being eliminated by the perspiratory and other glands, the albumen is taken up by the lymphatic glands and carried back in the form of lymph to the general circulation for further service.

ART. V.—CANADIAN WEATHER TELEGRAPHY AND STORM SIGNALS. BY FRED. ALLISON, M. A., *Chief Meteorological Agent, N. S.*

(Read March 9, 1874.)

I.—WEATHER TELEGRAPHY.

THE system of the Washington Signal Department, with which that of Canada is in co-operation, consists in collecting by telegraph, three times daily, reports of the state of weather observed at the *same absolute times* at numerous stations, (at present about 70,) and in forming thereon opinions of coming weather, which are sent by telegraph to the points concerned.

The wider the area of observation, the more correct are predictions likely to prove; and hence it is obviously to the advantage of the two countries, that the observations made in one should be placed at the disposal of the other.

Prior to July, 1872, as no pecuniary provision had been made for Weather Telegraphy in Canada, our operations were confined to sending to Washington regular tri-daily telegrams from Toronto and Montreal, and also, during six weeks, from four other stations.

Since 1st July, 1872, by aid of an additional grant of $5,000, regular tri-daily telegrams have been received at Toronto from six Canadian Stations, and have then been transmitted to Washington, there to be combined with the telegrams from the U. S. Stations, and thus contribute to the efficiency of the system in which we, as well as our neighbours, have so deep an interest.

As $5,000 is less than a quarter of the sum which I considered necessary for working the system in the present year, and wholly inadequate to procurring from the United States the *regular* tri-daily telegrams necessary for making forecasts at Toronto, the only direct service which I could render to our own ports has been to supply them occasionally with warnings based on *special* telegrams from Washington.

That these wanrings, have, on some occasions, reached their destination too late, is due entirely to defects in the transmission. A remedy for these defects will doubtless be found; and as all that

I hoped to effect with $5,000 was to *lay the foundation* and not to *complete* a system of storm warnings; the delays, though much to be regretted, form no reasonable cause for complaint.

As delays to some extent take place also in transmission from Washington to Toronto, the maximum degree of efficiency in Canadian telegraphy will not be attained till we are in a position to collect at Toronto all or nearly all the regular tri-daily telegrams from the United States, so as to make our own forcasts; but as in a work of such magnitude gradual development is safer than sudden expansion, I propose, during the year 1873–4, to rely chiefly on the Washington forecasts, and to apply our funds to the improvement of those forecasts by increasing the number of the reporting stations in Canada, to the erection of signal apparatus at various points along our coasts, and to perfecting our arrangements for the prompt delivery of warnings.

II.—STORM SIGNALS.

On receipt of a telegram from Toronto to the effect that a storm is apparently approaching the neighbourhood of Halifax, a storm *drum* will be hoisted at the yard arm of the storm signal mast erected on the Citadel by the Dominion Government. Storm notices will also be posted in the Dominion Building and in the Merchants' Exchange Reading Room.

A lantern showing a white light will be placed within the drum when it is hoisted at night.

The "storm" signalled must, for the present, be understood in a general sense, neither force nor direction being specified.

If there be good reasons to expect a heavy gale it will be thus stated in the notices; but the absence of such a statement will not show that a severe gale will *not* occur.

The drum and notices will usually remain up about twirty-six hours, unless ordered down by telegraph, and will remain up longer if a telegram to that effect is received from Toronto.

If through faulty transmission the telegram does not arrive before the commencement of the storm, the drum will nevertheless be hoisted upon the receipt of the warning, in order to show that the disturbance is not merely local. The display of the signal drum does not convey a distinct *prediction*, but simply indicates the existence of a storm elsewhere, and that the probability of its reaching the neighbourhood of Halifax is sufficient to call for vigilance. It must be understood that the utility of the drum for warning ships about to leave port is not impaired if the storm should be diverted from the immediate vicinity of Halifax.

Taking the above extracts from report and notice, by G. F. Kingston, Meteorological Superintendent, Toronto, as my texts, I propose to read a few notes on the present telegraphic branch of the meteorological system. For better understanding the present, it is advisable to look back briefly at the past. After the branch of climatological statistics, (on which I have here and elsewhere endeavoured from time to time to give some information) had been rooted but a short time in Nova Scotia—and still more briefly in many other portions of the Dominion—some pressure was brought to bear upon the leaders in this department to publish telegraphic reports of weather changes and warnings of approaching storms. This was the hasty action of the mass which always clamours for the so-called "practical results," never giving time for the truth contained in a theory to prove itself, and consequently falling into error from forgetfulness that Nature's mills though "they grind very slow, they grind exceeding fine."

In 1872 I proposed to the Chamber of Commerce in this city, to publish a daily bulletin of the chief characteristics of the weather here and at several stations in Canada and the United States; but there was an opposition in that body, partly from some who wished Government to undertake the whole expense of the enterprise, and partly from others who did not understand the objects to be attained, or the manner of their attainment. At that time Government was not prepared to inaugurate solely on its own account, and without the co-operation of the chief cities, the system which the next year it found itself enabled to begin. A little was however accomplished that Autumn in the way of receiving a daily bulletin from seven stations, and I feel grateful to those gentleman who deserve the thanks of the community for the assistance they rendered towards taking even that preliminary step.

But last year the greatest strides in telegraphic meteorology were made by the Department of Marine and Fisheries utilizing a portion of the Government grant in erecting storm signal staffs and constructing drums at many points throughout the Dominion.

In addition to the drum warning, a notice of the probable storm is posted in the Merchants Exchange Reading Room, on receipt of a cautionary telegram from the central office at Toronto. As yet it is evident that the public do not recognize the full intent and use of these notices. But that, from experience of other countries, was to be expected; and they will gradually learn, while we must work on in patience, constantly endeavouring to gain knowledge and to improve the system, so as to make its services more useful.

Regarding Nova Scotia at least, that there are grave defects in the present method of transmitting warnings must be allowed. These I am labouring to remove, and have lately communicated my ideas, as to improvement in that branch, to our Representatives in Parliament; that during the approaching Session at Ottawa, they may urge them upon the Department of Marine and Fisheries, under the control of which Canadian meteorology has been placed. I have good hopes of their success.

The present method of giving storm warnings is this, Washington warns Toronto from data collected throughout the Continent; and Toronto, in turn, forwards the Washington forecasts to Halifax. Some of the objections to this mode are obvious, especially the length of time necessary in the first place to collect and arrange observations—many of which are ultimately useless for forecasting in our district—and subsequently the roundabout route pursued by the telegrams to us, subject to the frequent delays and defects which accompany telegraphing on this Continent; and particularly liable to the detentions caused by the scarcity of night offices. I have no hesitation in saying that the forecasts could be better calculated for Halifax and other parts of this Province at this station, were it put in frequent communication directly with the proper points; not from any imperfection in arranging data at either Washington or Toronto, but simply because those observers are not so favourably placed for this district of observations. But the more obvious hindrances to continued accuracy in this branch, are not all nor even the most grave of those at present encountered.

To give correct opinions as to ensuing weather, it is an essential requisite that not only the temporary conditions of any atmospheric area during the disturbance under consideration be known, but that the normal temperatures and wind directions, the permanent hills and hollows of pressure, and even the geographical configuration, may have been the subjects of long study and intimate acquaintance. In this respect the local observer has an immense advantage. For myself it is nearly twenty-six years since I first gave attention to meteorology. This period has been much broken; and the observations of my earlier years are frequently inaccurate, from faults in instruments and position. But I now have eleven full years of trustworthy records for Halifax; and during the latest eight of these, the observations have been made in many months at bi-hourly, in some at tri-hourly, or at farthest at four hours intervals; so that, in statistical knowledge, the station may claim to be well equipped. Also there have been sent in to me from efficient observers, scattered through Nova Scotia, New Brunswick, P. E. Island and Newfoundland—besides a few in the Upper Provinces—many years of excellent registers. Thus constantly observing myself, and receiving this copious information, I cannot fail to have gained a stock of facts which lay open at my feet the regular conditions and extreme eccentricities of this climate. By no means disparaging the attainments of others at a distance, the office here must then have peculiar facilities for warning our own Province, merely from its position alone. In spite of the present disadvantages above mentioned, the Washington office has been very successful in its auticipations, as I now shall show.

Without going any farther back, that I may not overburden this paper with bare statistics, I merely take the past month of February; premising that the proportion of disturbances expected over this Province, held about the same ratio to the facts in the preceding four months since the storm staff has been erected as in this under discussion; while I regret to say that the number of late warning telegrams was also a similar share of the total.

During February then, we had seven storms. By the word "storm" I mean a gale of wind reaching at least a velocity of 20 miles per hour, for any one hour or more, accompanied by rain or snow, or neither—the latter case being very rare. A velocity of 20 miles per hour equals a pressure of 2 lbs. per square foot; as the square of the velocity in miles per hour, multiplied by .005, gives the pressure in lbs. per square foot, $V^2 \times .005 = P$. With this pressure it is calculated in the Royal Navy that a ship close hauled could just carry close reefs and courses.

On the 3rd. ult., light snow began to fall early. A snow storm began at noon; wind S. E. 15 miles per hour. Gale began 8 p.m. At 9 p.m. blew 21.5 miles per hour, and at midnight 30.7, having backed to E. At 1½ a. m. of 4th., wind reached its greatest rate of 42 miles per hour; decreased gradually till 3 a. m., and at 4 o'clock lulled. Snow fell fast till 1 p. m., with slight flurries in evening. From noon to 9 p. m. we had a very high wind from N.W., not quite a gale, but the reverse of the cyclone. A warning was sent from Washington but did not reach me till 4th, 11.35 a. m., 24 hours late.

On the 10th another snow storm began 7.5 p. m., but not so violent in any respect as the last. At midnight a N. E. wind was blowing 14.3 miles per hour. At. 3 a. m. of 11th, 20 miles were attained, and at same hour the snow ceased. Generally, after backing a few points, gales veer, lull, and come out from opposite quarter. They are cyclonic as the last mentioned. But in this storm the wind continued moving through N. to N. W., and finally to W.; blowing strongly from N. W. between noon and 3 p. m. of 11th. Telegram received 11th, 1 p. m., or at least 18 hours late.

At 1 a. m. of 14th, a S. gale was blowing at 20 miles per hour—at 3 a. m., 21.2 per hour—at 6 a. m., 23.7—at 9, 28.6—at 10, 27.1—at 11, 27—at noon, 26.7 from S. S. W., and at 3 p. m., had fallen again to 20 miles and quickly subsided. Light rain fell in showers during the morning, and more heavy and continuous in the afternoon. Notice was received here at 11.35 a.m., or 11 hours after storm was upon us.

On 16th, at 11.50 a. m., I was warned to hoist the drum; the wind then being S. E. at 15.5 per hour. This rate was not exceeded during this disturbance, but considering the evident proximity of a much heavier blow, the notice would have been prudent if sent from 12 to 20 hours sooner. Heavy snow, sleet, rain, fog, and drizzle were all present here that day.

Between 11 a. m. and 6 p. m. of 20th, we had a short and sharp blow from S. W., at times rising to a gale; and accompanied with violent rain. Of this Washington sent no advice.

A caution was received on the 23rd at 1.30 p.m. I doubt the expediency of sending this telegram at all; but certainly, if sent, it should have been forwarded much earlier. A light snow fell on that day from 7.45 a. m. to 8 p. m.; and a wind, from N. E. to S. E., never exceeded 14 miles per hour. Midnight was calm and foggy.

On the 26th snow began to fall gently at 0.30 a. m. From 1 to 10 a. m., it snowed fast. The wind backed from S. at midnight of 25th, to N. at 2 p. m. of 26th; blowing very unsteadily, and very rapidly at intervals, but never passed 14 miles in one continuous hour. The warning was not delivered here till 9.10 in the morning, when the greatest velocity was being attained; but still it was a fair forecast, and had the telegraph done its duty throughout, would have been in my hands before midnight of 25th.

Of these seven storms, six were foreseen at Washington; but only one warning was sent from Toronto to Halifax in time to be useful here; and that was marred by telegraphic delay. No caution was sent in one instance only that of the 20th. I have thought it unnecessary to dwell here upon the fact that notices, though late, are of use in demonstrating the wide range of storms beyond the locality warned; especially in shewing seamen the path and progress of these atmospheric disturbances; as that discussion would open up a field differing from that immediately under consideration.

Art. VII.—On the Seals of Nova Scotia. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read March* 9, 1874.)

FAMILY PHOCIDÆ.

Calocephalus vitulinus. F. Cuvier. Gray.
Phoca vitulina. Linn. Gill.
Phoca concolor. Dekay.

Common Seal. Harbor Seal.

Pagophilus Groenlandicus. Gray.
Phoca Groenlandica. F. Cuvier.

Saddle Back. Harp Seal.

Halichœrus grypus. Gray. Nilsson. Gill.
Halichœrus gryphus. Bell.
Phoca grypus. O. Fab.

Grey Seal.

Cystophora cristata. Gray. Nilsson.
Phoca cristata. F. Cuvier. Dekay.

Hood Seal.

Of these four species, two may be called residents of Nova Scotia, the Harbor Seal, and the Grey Seal. The others are only chance visitors, or are brought down the Straits of Bellisle on the ice, by the Arctic current to the northern shores of Cape Breton, in early spring. Another species not uncommon to Newfoundland, called Square Flipper by the fishermen, may also reach us; I never have had an opportanity of identifying them, but suppose them to be the Phoca barbata of Gray's list, B. Museum.

Calocephalus vitulinus.

THE COMMON OR HARBOR SEAL.

A skull of this species from Sable Island lies before me. It measures eight and one half inches in length. The teeth are, upper jaw three inscissors one canine and five molars; the first are very small. On the lower, two incissors one canine and five molars. The upper teeth are much worn, but on the lower jaw the beautiful lobed structure, so well described by Bell and Nilsson, is well exhibited—the large lobe in the centre, one small one in front, and two behind. These together with the peculiar structure of the nasal bones, the outer edge prolonged beyond the inner, the deep notch in the palatine bone, the palatine foramina in the maxillar bone and the oblique position in the jaw of the molars themselves, so exactly resembling the seal of the European seas, leave no doubt of their identity. Thus the habital of this seal is from New England to Greenland—to Iceland coming down to the British and French seas, and extending, according to Pallas, to the Caspian and Lake Buikal. Though Godman described this seal as P. vitulinus, and Dekay coming after, called it P. concolor, apparently with no other reason than the prevailing feeling amongst American naturalists of non-identity of old and new world species, yet we owe to Dr. Gill, Smithsonian Institute, in a paper published about a year ago, to have exactly determined the fact, which he did by comparison of skulls sent him from Sable Island. I regret I have no exact notes of its outward appearance. Many measure six feet, though five feet is the more ordinary length. The head is roundish and face whitish, with a dark spot above the eye, from which, three or four bristles spring, the fore flippers have five well developed fingers connected with webs, and armed with five claws of dark horn color. The hind flippers have also five fingers webbed, with five claws smaller than the fore. In the fore, the middle is the longest; in the hind, the two outside are the longest. The wrist is much more developed from the integuments than in other seals. The eye is very large and flat. There is an external orifice in the ear but well covered by the fur. The nostrils are linear with a deep line between them, and the lips are tumid and ornamented by numerous bristles. The color of the live animal wet, as he habitually is, with the fur plastered down smoothly to his figure, is a sluty ground, deeper upon back and lighter upon belly, on which are more or less penciling of black, sometimes spots, sometimes running into lines, usually a complication of both. When dry, the fur becomes more erect, and the light slate becomes greyish fawn. When you examine the dead skin at the fur dealers, you find a pale sea green pervading the whole skin with the dark pencelling on it and the hair erect and dry. A seal coming out of the water to bask in the sun, is nearly black, but as he dries he gets lighter and lighter until he is almost fawn. I could tell by his appearance, almost, how long he had been out of water.

A young whelp apparently a week or ten days old was dark slate upon the back, lighter on sides and belly, with about a dozen round black spots on his sides. The face in the adult is lighter and the flippers darker than the body. This seal is common to every port of Nova Scotia. I have seen them in the Annapolis Basin and the Bay of Fundy. They are found at Yarmouth and along the eastern coast, and a few every winter pass the crowded wharves of Halifax, and are seen in groups on the ice at Bedford Basin, or riding to sea on its fragments as the ice is swept seaward by a heavy north-wester in early spring. But vigilant and shy, it loves lone unfrequented shores, and thus Sable Island is its great stronghold. Here, at least, some thousands perpetually dwell, and some years ago I watched their habits with great pleasure. On the north side of the island you only met with single ones or pairs roaming inside the bars about five hundred yards from shore, whilst on the south side, exposed to the whole swell of the Atlantic, we found them in herds. I supposed their food was plentier on that side. They would follow me on horse back for miles, the whole herd accompanying me just outside the breakers, with their heads turned towards me. Sometimes their curiosity tempted them inside the breaker, when they always dove to escape the foamy dash. It was a pretty sight as the sharp edge of the wave curled up and thinned out before it broke, to see three or four of them through the transparent water, as it lifted them above the sea level and showed them struggling to avoid its creamy dash. But though so much at home on the sea, they all love to bask upon the warm sands. They were very fond of the placid waters of the inland lake, and taking advantage of an opening from the sea forced in by the late heavy weather, hundreds of them would be sporting on its shallow waters or lying in scores on its yellow beaches. They looked at a distance like stony reefs, so motionless was their rest. At dawn of the early May mornings we found the new born whelps, born of the night, lying on the shores. They were very dark, very velvety, about two feet long, with most lustrous eyes deeply steeped in sleep. These little sea babes snaped and snarled and made every hummochy exertion to escape seaward, the mother meanwhile swimming in restless circles a half gun-shot from shore. Being placed in the water for the first time no doubt, it instinctively flattened itself, dived and reappeared upon its mother's back, who soon carried it far from our baneful presence. We must have broken in upon her nursery laws, as the whelps generally do not take the sea till twenty days old, and then very cautiously, trying the shallow pools first. About the middle of July these whelps had grown to four feet in length, (they measured to my breast) and weighed about sixty pounds. They were constantly on shore and seemed to require a great deal of sleep. They slept constantly upon their backs and very sound, whilst the old ones slept upon their bellies, their head slightly turned upwards. As their hind flippers were also turned up, this gave them the appearance of beached canoes at a distance. In all the representations of seals I have never seen this attitude depicted. I could always approach a young one, but the old, ever vigilant, went off in their hummocky gallop, using certainly their fore flippers, but more the abdominal muscles, at such a slapping pace that a smart gallop brought me to the land wash with the whole herd struggling in the creamy breaker, that now twisting my poney's legs from under her, was warning me to pull her out. They usually accompanied me after this for three or four miles, keeping even with me just outside the breaker as I rode along the solitary beach. The whelps at the end of July, being worth from two to three dollars for their skins and oil, are mercilessly run upon and clubbed. We shot many from the shore and our boats. A seal rising his head above water keeps his eye intently on you, presently he turns to dive, throwing the round arched up back of his neck towards you. This is your mark, if you put your charge of seal shot well in here, a large circle of blood and oil instantaneously spreads itself on the water. In the centre, bobs up and down the tip of its nose, shot dead but slowly settling to the bottom. A young seal of this species, taken in Halifax Harbor in May, and probably three or four days old, was about two feet long and dark blue on back, slaty blue sides and belly with a dozen or more black spots beneath. It easily turned itself round by its fore flippers, but used its stomach muscles in going ahead, the hind flippers were trailed behind as if useless. The nose was blunt with a deep sulcus between linear nostrils, cheeks tumed and ornamented by bristles.

Pagophilas Groenlandicus.

The Harp.

I insert this seal on the Nova Scotia list not upon my own personal knowledge, but very common in Newfoundland and Labrador. The arctic current dividing north of the Straits of Bellisle, sweeps down the ice by the western shore of Newfoundland, and thus packs the northern shores of Cape Breton. In the Spring of 1874, this ice was filled with seals, seen and taken readily from the shore, which I presume to have been both Harps and Hoods. The Harps of Newfoundland are identical with those of Greenland, the North Sea and Shetland Isles. The whelps are often brought to Halifax by the sealers, but usually all die. In studying one belonging to Mr. Downs, I observed that he constantly swam when under water upon his back, coming thus to the surface and turning over to dive again.

Halichœrus grypus.

Grey Seal.

When on Sable Island I noticed a large seal that frequented the bars in herds of twenty or thirty. They kept by themselves, were very vigilant, came in December, whelped in February or March, and stayed about the Island till August. There were none killed, and the only observations I could make were that the large ones or males had fine bristly tumed cheeks; the young were white, not yellow, and that they were generally double the weight of the common seal. The old males winded me before I came in sight over the sand dunes, and a rapid gallop brought us altogether in the foaming land wash. Deep trails were worn in the sand, from the wide sand-baths they were luxuriating in, down to the wet tide wash. The men told me the whelps changed their coats a few days after birth, and before they took the water. In a paper published about two years ago by Dr. Gill, Smithsonian Institute, he identifies this seal with the great grey seal of the Scottish and Irish coasts, so well described by Bell and Nilsson, who first separated it from the common seal. His observations were made upon the skulls and skins sent him by Edward Dodd, Esq., late Superintendant of the Island.

Cystophora cristata.

Hood Seal.

In May, 1874, an old female hood seal was taken on a bultow line in one hundred fathoms water, Sambro banks, about twenty miles from the Nova Scotia shore. It was brought into Halifax harbor where I saw it. It measured,

Nose to end of tail	7 feet 3 inches.
To end of flippers	7 feet 6 inches.
Tip of nose to eye	6 inches.
Tip of nose to fore flipper	2 feet 3 inches.
Length of fore flippers	10 inches.
Length of hand flipper	1 ft. 1 inch.
Length of tail	8 inches.
Diameter of eye	2 inches.
Mustasche bristle	2½ inches.

In general appearance this seal was very round but tapering off suddenly to the tail. The head seemed small, neck long, but all swelling lines marking head from neck, as seen in most drawings, were obliterated in fat. There was no mark of a hood upon the forehead, except a protuberence of the nasal cartilage, causing a slight prominence of the profile. The eye was large and flat, with a nyctitating membrane from the inner corner. I could easily pull the uper lid over the eye, though Dekay says of his specimen it had none. Close behind the eye, was an orifice for the ear well covered with hair which ran down its interior. A finger might easily have been put into it, but less than an inch from the surface it would be stopped by a membranous valve like tragus. The muzzle blunt and hairy, slightly tumed, was ornamented by rows of thick brownish bristles. Three bristles of the same kind were above the eye. These bristles were wavy, from slight prominences or thickning alternately on either side. The nostrils were perpendicular, parallel or scarcely converging below. The fore flipper was two feet three inches from end of nose, very small, (ten inches long) scarcely showing the carpus from beyond the integuments, and divided into five distant toes with webs between. The toes were all armed with sharp nails or claws, the longest, one inch and a quarter long, pearly white and very sharp, and just reaching beyond the fur. The first toe is the longest, and they gradually shorten to the fifth. The fur is longer upon the flippers than on the body, yet it looks very small comparing it with the rise of the body. The hind flipper is fourteen inches long, containing five toes connected by webs, each toe has a small pearly white rudimentary nail and the two outside toes the longest, the middle shortest, and the webs when stretched out a darker color than the fingers. The tail was about eight inches long and dropped between the hind flippers. There were four abdominal mammœ hid in the fur and about five inches apart in two rows. As regards color, when wet the head fore and hind flippers are black. The back and sides have irregular black patches running into each other on a greyish blue ground. The neck has a checquered look from the spots being smaller and the belly a lighter hue, from there being fewer of them. When dry this greyish ash becomes pale fawn, that is in life, the seal basking in the sun. The dead skin seen at the fur dealers has a greenish hue added. In life the whole surface has a smooth plastered look which in the dead skin becomes rough and uneven. Nearly all the colored drawings of seals represent them in life but colored after the stuffed specimen or dead skin at the dealers, and hence has arisen the confusion of color and the apparent diversity in the accounts of Naturalists. The skull measured nine and one half inches in length, and six and a quarter in width. The bones very massive and muscular ridges large. The palatine foramena came out at the junction of the maxilla and palate bones, and a shallow canal passed forward from them. Edge of palate transverse with no notch. The intermaxilla bones were very large and the nasal cartilage greatly developed at the muzzle. The teeth were, upper jaw two inscissors, one canine and five molars; the lower jaw the same except only one inscissor. The crowns of the molars were much worn, but the cutting edge maintained a lobular form, and the outside of the enamel had the fine ocinilation described by previous authors. The molars were widely separated from each other, as were indeed all the teeth, though in a less degree. This skull compared exactly with the figure in Gray's "Catalogue, Seals B. Museum."

This seal is only a rare visitor to our shores. As I have before said the common or harbor seal and the great grey seal are our only residents. But as the Walrus, now a much more arctic species was once common here, there can be little doubt that all the North-eastern American species once dwelt on our shores. The early French writers as well as the English traders to New England, can scarce find words to express the teeming life of seals, dolphins, porpoise and whales which fed upon the migratory fish that literally thickened the seas around. They have all passed away. The fish have nearly followed them, leaving as problems how an arctic climate and loss of genial heat, may have modified their former somewhat equatorial habits and forms, as some moderns asert the whales which once sported in our sun-warmed shallow waters, dare not now pass the warm Gulph Stream. I have followed the classification of Gray B. Museum, giving the synonymes of American authors.

Art. VIII.—Nova Scotian Geology, by Rev. D. Honeyman, D. C. L., F. G. S., &c.

(*Read April 13th*, 1874.)

COBEQUID MOUNTAINS, &c.

About three miles west from the Wentworth Station, of the Intercolonial Railway, (*vide, preceding paper by the author*) we find ourselves on the north side of the Cobequid Mountains, and on the road from Greenville to the Londonderry Iron Mines. Here we find the lower carboniferous conglomerate and the red syenite. Any intervention of the bands of rocks which occur on the Intercolonial Railway, between Smith's Brook and the carboniferous of Caldwell's Brook, as I previously noticed there, have been denuded and overlaped.

Near Purdy's Inn, West Chester, on the road from Amherst to the Londonderry Mines, we find the lower carboniferous conglomerate and the red syenite occurring in a similar manner. This position is six miles distant from the preceeding. The outcrops along both roads, southward to their meeting point, are of granitoid rocks: syenites and diorites. Between this point and the county line there are outcrops of granites. The granites are evidently massive, they are fine grained and of dark colour. South of the county line we have outcrops of the next band; these exposures exhibit much greater variety than was seen on the Intercolonial Railway. In one exposure the strata are beautifully banded. The dark green homogeneous diorites having interbedded red and green gneissoid strata; other exposures show massive homogeneous diorites; others show gneissio and quartzite strata, and the last exposures, a little below the bridge on the east side of the road, shows dark green diorite, which may readily be mistaken for uncrystalline rock, the hammer however shows that it is characteristically hard and crystalline. These are succeeded by uncrystalline rocks, as on the Intercolonial Railway. By exposures we find that the band in this direction is about half a mile wide. About the middle of it there is a great deposit of ankerite. At the time of my last visit, in 1866, this was not worked. It is now used as a flux instead of the limestone formerly used. Besides being a flux it adds 25 per cent. of iron, the iron thus produced is adapted for *chilling*.

The extension of these strata, east and west, contains the deposits of limonite. The largest deposits lie to the west of the ankerite. In the same band there occurs a red hematite, which is used with the limonite and ankerite. These deposits all appear to be in the upper part of the band, and are probably of Upper Silurian age. The greatest width of the band is in the region of the red hematite, There it seems to be about a mile in width. Succeeding this band is the carboniferous of the Intercolonial Railway. The slates of the *ankerite* are overlaid by lower carboniferous conglomerate, those of the *red hematite* by lower carboniferous limestone. This difference of rock seems to account for the difference in width of the Silurian band in the ~~bed~~ two localities, as conglomerate forming conditions are destructive, and limestone forming conditions conservative; the one being formed from the tear and wear of rocks on the shore, the other being formed in the depths by marine lime-forming invertebrates. This conglomerate and limestone may therefore be regarded as cotemporaneous. It is not unusual to find lower carboniferous limestones lying directly on pre-carboniferous rocks. The Pictou Coal Field furnishes many examples.—*Vide Transactures*, 1870—1–2 *Papers, by the author.*

Following the course of Great Village River, from the Londonderry Iron Works, we have a fine section of this carboniferous band, more distinct even than that of the Intercolonial Railway. In this, about three miles from the iron works, we have a quarry which once was the haunt of reptiles of the middle carboniferous period. *Dendrerpeton acadianum*, Owen, or his congeners. From this locality there is a sandstone slab in the Museum, which has three fine setts of casts of right and left reptilian tracks, one sett traversing it longitudinally and the others crossing and recrossing nearly at right angles. We have thus met with reptiles on either side of the Cobequid Mountains, of the same period, but in different geological horizens, the one being of the lower and the other of the middle carboniferous formation. Not far from the quarry we have the commencement of the new red sandstone, permian and trianic. This is also well exposed on either side of the river as far as the Great Village, exhibiting the same characters as on the Intercolonial Railway. Beyond the Great Village all is obscure.

We would again traverse the Cobequid Mountains from the north, beginning at the county line, two miles west of the Intercolonial Railway, and on the road to Five Islands. We are on the north side of the central band. The underlying rock, as shown by the outcrop, is granite. This granite is coarse and porphyritic, the mica is black, the felspar is reddish white; it is different from any other granite that I have met with in Nova Scotia—in position. I have found it frequently in boulders, and specimens have been brought to the Museum from Cape North, in the Island of Cape Breton. This granite is succeeded on the north by lower carboniferous conglomerate, in the same manner as are the syenites of West Chester and Greenville; the Silurians, of Wentworth, being still absent or overlapped. It is thus probable that forty square miles, at least, of crystalline and uncrystalline rocks have been denuded and obscured on this side of the Cobequid Mountains by the lower carboniferous seas. This lower carboniferous conglomerate is the southern base of the Cumberland Coal Field. Crossing the Mountains towards Five Islands for a long distance no outcrops are seen; the surface boulders and soil seem to indicate three or four miles of underlying granite, similar to that of the outcrop already noticed. Farther on we have frequent outcrops of granitoid rocks—syenites and diorites. About two miles from Five Islands the outcrops are of bedded crystalline rocks—gneisses and quartzites. The extension of these to the east, on North River, shows syenitic gneiss with crystalline limestone (marble). This marble is well known, it has been quarried to some extent with the expectation of obtaining masses fitted for sculpture, but without success.

The position of this marble and its associations are sufficient to indicate its relationship to the marbles and serpentines of Arisaig, N. S., and George's Mountain, C.B.—*Vide Transactions*, 1872-3. *Paper by the author.* The syenitic gneiss, in the vicinity of Bass River, seems to belong to the same band of rocks. This seems to overlie the strata which contain the *barite* veins of Five Islands. It will require still farther investigation to determine these points. The peculiar lithology of the barite containing-rocks, and their great contortion, are difficulties in the way of settling this question, although these apparent difficulties may not amount to much in the face of systematic and thorough investigation. The *barite* has been somewhat extensively mined for the manufacture of white paint.

From the river below, the lofty, extensive and precipitous exposure of rocks, with its numerous pigeon holes, (adits) and shoots for conveying the mineral to the river, and picturesque surroundings, present a scene striking and imposing.

Returning to the mountain road we have, succeeding the crystalline, a band of uncrystalline rocks—slates and shales, an extension of the slates and shales of the Intercolonial Railway section and the Londonderry mines. These present no feature of importance.

At last we come to Harrington River, on the right side of the road, with its section of the carboniferous band of the Intercolonial Railway. Here we have a considerable thickness of slates, which very much resemble the slates of the preceding band. They are unconformable to the Upper Silurian. Many of the strata are beautifully ripple marked. These are succeeded by black strata, having shales with *modiola*, patches of scales of *palæoniscus* with *modiola* and *cordaites* (*?*) These are unmistakably lower carboniferous. The section of this formation extends onward to the mouth of the river, where it is overlaid by the new red sandstone. This band extending to the shore is terminated by Trap, an extension of that which constitutes a great part of the Five Islands and Gerrish Mountain. The trap of these Islands is celebrated on account of its minerals. That of Gerrish Mountain has a vein of *magnetite*—magnetic iron ore.

The trap at the end of the section has elevated the strata in this direction, and given the new red sandstone the form of a synclinal. On the road side, about a mile to the eastward, we find an exposure of the same band, having a southerly dip. This has received its direction from the trap of the Islands.

Gerrish Mountain is the eastern extremity of the trap which crosses the Bay of Fundy to Blomidon, and extends westward to Digby and Briar Island.

Intercolonial Railway.

On referring to the Section Book we get the following measure ments :—

Folly Lake 602 feet above the sea level—

Crystalline rocks of Smith's cutting...........507.
Rocks of "Wentworth" cutting..... ....490.
Middle Silurian cutting, near Caldwell's Brook.453.
Lower carboniferous conglomerate. ....450.

If we consider the conglomerate as having been formed on the approximate level of the sea, at the beginning of the carboniferous period, then the position of Folly Lake at that time was one hundred and fifty two feet above the sea level. The rocks of Smith's cutting fifty-seven feet, of Wentworth forty feet, and the Middle Silurian rocks, next the conglomerate, three feet. The Mountains of the Cobequids, which now rise to the height of eight hundred feet, were no higher than three hundred and fifty feet, and West Chester Sugar Loaf, the highest mountain in this range and in Nova Scotia, which now rises to a *reputed* height of one thousand two hundred feet, was elevated seven hundred and fifty feet above the surface of the waters. McNeil's Mountain, Arisaig, the highest in the east (one thousand and ten feet) rose to a height of five hundred and sixty feet; and the loftiest of the mountains of Cape Breton (nine hundred feet) were only four hundred and fifty feet in height.

Correlation.

I have already directed attention to the probable relationship of the crystalline, uncrystalline, and fossiliferous pre-carboniferous rocks of the Cobequid Mountains. From a Dominion point of view I would now turn to England.

On examining Prof. Ramsay's great work "on the Geology of North Wales," I find in page 90, fig. 20, a representation of an almost exact counterpart of the northern part of the Intercolonial Railway section. The Wales section runs thus:

1,—Syenite.
2,—Speckled felspathic and talcose flaggy beds, Llandeilo and Bala beds.

3,—Felspathic ashy conglomerate.
4,—Slate.
5,—Felspar porphyry.
6,—Blue slate.
7,—Felspathic trap.
8,—Blue slaty beds.

"In places the trap No. 7 is slightly hornblendic, and although probably intruded between the beds it may possibly be a regularly *interbedded lava flow*," *page* 96. In explanations on Plate 28, Section No. 3, the syenite, porphyries and greenstone are referred to the *Lower Silurian*.

The adding of a new *Fauna* to the Silurians of Nova Scotia seems to be a fitting time for making a few observations on the *Fauna* already known.

By common consent the fauna of Arisaig is regarded as typical of the Middle and Upper Silurian of Nova Scotia. All however are not agreed on the points of *range* and *relationship*.

With the aid and counsel of J. W. Salter, Esq., late Palæontologist of H. M. Survey of Great Britain, I made a subdivision of the Arisaig Series in 1863—Vide Paper by the Author "On the Geology of Arisaig." *Geological Journal*, 1863.

The division then made was *alphabetical* and British as follows:

A................. Mayhill Sandstone—Salter.
B. B'.............. Lower Ludlow.
C................. Aymestry Limestones—Salter.
D................. Ludlow Tilestone—Salter.

After the lapse of 10 years and a great amount of labour and research, I consider that the alphabetical division is the only unobjectionable one that has been proposed, and that the only modification of the British division required is the omission of the "Lower Ludlow," which was not suggested by Mr. Salter. Previous to Mr. Salter's examination and correlation, I had correlated D. with the Upper Ludlow of Wales, and Dr. Dawson had at the same time correlated C. and D. with the Lower Helderberg, U. S., and B'. with the Clinton, U. S. D. and C. are farther distinguished by Dr. Dawson, Upper Arisaig, and B'. Lower Arisaig. Extensive observation has proved that Mr. Salter was correct in giving the Arisaig Series a greater range in time than that given by Dr. Dawson.

At Arisaig the Mayhill sandstone of Salter occupies the lowest position in the Series, and it has the same relative position in the several localities where it occurs in Nova Scotia. Its characteristic *fauna* is perfectly distinct from that of the others. Its *lithology* is also peculiar. While the other fossiliferous strata of the group are *argillaceous* this is highly siliceous—parts are *simply sandstone*. In one locality the strata are siliceous and the contained fossils are silicified casts. I have no difficulty whatever in recognizing the Mayhill sandstone strata from their relative position and lithology, when I find them, and the characteristic fossils appear as a matter of course. In previous papers I have given my reasons for distinguishing B. and B'. into Lower and Upper Clinton. I have followed the example of Hall in dividing the Arisaig Series into Middle and Upper Silurian. I have also been in the habit of correlating it thus :

	England.	*United States.*
A.	Mayhill Sandstone	Medina Sandstone.
B.		Lower Clinton.
B.'		Upper Clinton.
C.	Aymestry Limestone	Niagara Limestone.
D.	Upper Ludlow	Lower Helderberg.

A. B. B'. .... Middle Silurian.
C. D. .... Upper Silurian.

In correlating the Arisaig Series with the United States divisions. I have found it difficult to correlate D. with the Lower Helderberg, notwithstanding that I had access to the best American authorities, and lists of figures. I am not surprised that Hall and others regarded the fauna of D. as Devonian, as they appear to have a greater resemblance to the Hamilton and Chemung than to the Lower Helderberg. The *facies* of the *fauna* of D. is strongly English, I experienced no difficulty in recognizing it in the Upper Ludlow of *Murchison's* Siluria. I believe that it is only through England that it can be correlated with the Lower Helderberg of the United States. C. is easily correlated with the Niagara limestone of the United States. B'. is with common consent admitted to be of Clinton age, United States. I have designated B. Lower Clinton, for reasons already given. I have not been able to correlate

A. Mayhill sandstone of Salter, directly with the Medina sandstone, United States. As it is distinct from B. and B'. Clinton and underlies it, it is reasonably regarded as the approximate equivalent of the Medina sandstone, United States. In addition it is also a sandstone. Sometimes I am disposed to subdivide and to make the metamorphosed part in conjunction with the trap of Arisaig Pier, and other parts of the shore—Oneida conglomerate, United States.

I have referred to another division of the Arisaig Series into Upper and Lower, the Lower Helderberg equivalent being the Upper and the Clinton the Lower Arisaig. There are two applications of the word Arisaig. There is the Arisaig Township and the locality Arisaig. In the former sense it is much too restrictive as it ignores a great part of the Arisaig Series—besides a typical series of crystalline rocks which I have elsewhere designated as "Lower Arisaig" and carboniferous rocks. In the latter sense it includes too much, as the "Lower Arisaig" of the Division *alone* lies in Arisaig, while the "Upper Arisaig" is in Moidart. On these grounds I consider this division as untenable.

From the considerations already stated I have long regarded the Silurian *fauna* of Nova Scotia as Anglo-American. When Mr. Salter examined my Arisaig collection at the London Exhibition of 1862, he marked particularly the English fossil *Grammysia Cingulata*. Upon the authority of Professor Dana,—this is a foreign form which has not been found elsewhere in America. In England this fossil occurs in the Ludlow tilestone. In Nova Scotia it occurs in the Upper Clinton of Arisaig. So that the Nova Scotian *Grammysia Cingulata* is older than the others, and may therefore at present be regarded as the *ancestral Grammysia Cingulata*.

In England and elsewhere Sir R. J. Murchison's division of the Silurian system into Upper and Lower, has been generally accepted. In America eminent Palæontologists, *e. g.* Hall and Billings, have divided the system into Lower, Middle and Upper. This is the division adopted by the New York and Canadian Surveys. Professor Ramsay in his *Geology of North Wales*, proposes a modification of Sir R. Murchison's division. Between the Upper and Lower Silurian he distinguishes an *Intermediate*

Series. This includes the Llandovery rocks, page 2. He adds: "The lists of the Geological Survey show that about ninety species of fossils are known in the Lower and Upper Llandovery strata of Wales and its neighbourhood. These, taken together, are, on the whole, so distinctive that it has been proposed to divide the strata in which they occur into a middle Silurian Series, page 231.

The difference between Professor Ramsay's Middle Silurian and our Nova Scotian Silurian is, he begins with the Mayhill sandstone (Upper Llandovery) and descends; including the Lower Llandovery. I begin with the Mayhill sandstone and ascend, including the Clinton.

Distribution of the Upper Arisaig Series.
Localities.

D. Upper Ludlow, England. Lower Helderberg, United States| Arisaig and Lochaber, Antigonish County. Springville, Irish Mountain, Blanchard, Merigomish, McLellan's Brook. Sutherland's River and Earltown, Pictou County.

C. Aymestry limestone, England. Niagara limestone, United States.| Arisaig and Lochaber, Antigonish County. Springville, Pictou County.

B'. Upper Clinton, United States.| Arisaig, East River, Blanchard, Irish Mountain, Sutherland's River, French River, Cobequids.

B. Lower Clinton, Arisaig. Barney's River, Sutherland's River.

A. Mayhill sandstone, England. Medina sandstone, United States.| Arisaig, Lochaber, Marshy Hope, Barney's River, McLellan's Mountain, Sutherland's River.

It will be observed that the Counties of Antigonish and Pictou, include all the above mentioned localities where we find rocks containing Arisaig fossils. In the "Webster Collection," in the Provincial Museum, there is a small collection of fossils which appear to be of the Arisaig type, although these are not recognizable characteristic fossils. It is possible that they are from localities in the western part of the Province, mentioned, in "Dawson's Acadian Geology." These localities I have not yet examined.

Art. IX.—Meteorology 1873, Halifax, N. S. By Fred. Allison, M. A., *Chief Meteorological Agent.*

Having already in another paper this season, laid before the Institute the progress of Weather Telegraphy and Storm Warnings in Canada, in this communication I merely rehearse the results of observations at Halifax in 1873, taking them up where dropped in December 1872. The succeeding January opened with a high and ascending Barometer, which was generally maintained. After the snow fall of the last night of the past year, the Temperature fell considerably, giving a clear and cold New Year, with excellent sleighing. The month was not, however, very cold; its mean Temperature being 23.°59 or .56 above the corrected mean of January for eleven years. N. W. wind, as usual, preponderated, with but little velocity. The total precipitation, 7.83 inches, was very large. Rain and snow both exceeding, but especially the latter. We had 3 auroras, 2 fogs, and miscellaneous phenomena not numerous. But once the wind reached a gale on the morning of 28th, accompanied with six inches of snow. Heavy sleet and snow were falling the previous evening. At night the wind backed from S. E. to N. N. W., and snow increased in the morning till 8h. 15m. when it ceased. Thunder and lightning at 4 a. At 6h. 30m. a wind blowing 33 miles per hour, and then fell. The following day grew very cold, and at 7h. 30m. a. of 30th Temperature was 14.°4 below zero—the minimum since 7th January, 1866.

February showed a marked decrease of pressure, and somewhat below its own normal. It was steadily cold 2.°80 below the mean of February, and being nearly 3° colder than the preceding January—an unusual occurrence—there being in a long series but very little difference between these two months, and January on the whole the coldest. Prevalent wind N. W. A noticeable decrease in rain and snow took place—only 0.49 of an inch of the former being measured, and 10.7 inches of the latter; so that the month was a fine one, though very cold. Two gales took place; neither very heavy. The 8th began with sleet, then heavy rain, and S. E. gale in morning. A shower in the forenoon. Fog at 'egister for 1873.

SCOTIA.

West. Height above Sea, 98.5 feet.

LLISON.

	ne.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year 1873.
Mean T	5.37	63.43	62 87	56.81	49.37	33.32	25.38	42.24
Differe	3 90	-.05	- 35	-.57	+1.02	-4.08	-.37	-.68
Maxim	86.0	87.5	87.4	85.0	70.8	59.2	53.9	87.5
Minim	35.3	41.8	43.8	38.5	29.8	6.8	-2.9	-14.4
Month	50.7	45.7	43.6	46.5	41.0	52.4	56.8	101.9
Mean	7.82	76.79	75.99	68.63	59.96	40.92	33.34	52.92
Mean	6 13	54.50	53.99	48.54	41.06	25.77	16.55	33.55
Highes	7.20	69.22	69 54	66.25	60.77	50.24	48.71	69.54
Lowes	5.02	52.97	51.27	49.44	38.56	13.80	7.99	-2.18
Mean	1.68	22.29	22.00	20.09	18.90	15.15	16.78	19.37
Greate	36 3	30.8	41.9	31.8	29.7	31.0	42.0	42.0
Mean	4.88	53.05	51.55	46.57	37.74	25.20	....	....
Mean	.795	29.854	29.888	29.914	29.965	29.718	29.907	29.818
Differ	.035	+.087	+.109	+.065	+.144	-.010	+.156	+.051
Maxin	.282	30.129	30.214	30.347	30.424	30.362	30.647	30.825
Minim	.320	29.436	28.889	29.306	29.309	28.716	28.898	28.676
Montl	.962	0.693	1.325	1.041	1.115	1.646	1.749	2.149
Highe	.206	30.081	30.185	30.297	30.313	30.328	30.608	30.639
Lowes	.409	29.549	29.207	29.437	29.483	28.817	29.166	28.801
Mean	.330	.466	.453	.371	.299	.165	.122	.272
Mean	74.9	79.8	79.4	79.0	81.8	80.0	77.7	79.0
Mean	5.97	5.88	5.69	5.49	5.33	5.80	6.30	5.78
Differe	-.03	+.27	+.23	-.21	-.11	-.82	-.36	-.20

General Meteorological Register for 1873.

HALIFAX, NOVA SCOTIA.

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

OBSERVED BY F. ALLISON.

1873.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year 1873.
Mean Temperature	23.54	20.58	30.09	38.07	48.00	55.37	63.43	62 87	56.81	49.37	33.32	25.38	42.24
Difference from Normal (eleven years)	+.56	-2.80	+1 78	-.05	+.56	-3 90	-.05	-35	-.57	+1.02	-4.08	-.37	-.68
Maximum Temperature	52.4	43.3	48 0	62.7	81.5	86.0	87.5	87.4	85.0	70.8	59.2	53.9	87.5
Minimum Temperature	-14.4	-12.0	3.8	24.1	24 0	35.3	41.8	43.8	38.5	29.8	6.8	-2.9	-14.4
Monthly and Annual Ranges	66.8	55.3	44.2	38.6	57.5	50.7	45.7	43.6	46.5	41.0	52.4	56.8	101.9
Mean Maximum Temperature	32.57	30.52	38 27	48.12	62.07	67.82	76.79	75.99	68.63	59.96	40.92	33.34	52.92
Mean Minimum Temperature	14.35	10.50	22.66	31.11	37.39	46 13	54.50	53.99	48.54	41.06	25.77	16.55	33.55
Highest Daily Mean Temperature	47.77	35.47	37.74	45 19	61.25	67.20	69.22	69 54	66.25	60.77	50.24	48.71	69.54
Lowest Daily Mean Temperature	-2.18	-1.11	17.54	31.97	31.76	45.02	52.97	51.27	49.44	38.56	13.80	7.99	-2.18
Mean Daily Range of Temperature	18.22	20 02	15.61	17.01	24.68	21.68	22.29	22.00	20.09	18.90	15 15	16.78	19.37
Greatest Daily Range of Temperature	39.2	32.1	31.5	31 6	40.1	36 3	30.8	41.9	31.8	29.7	31.0	42.0	42.0
Mean Terrestrial Radiation	....	....	....	....	35.23	44.88	53.05	51.55	46.57	37.74	25.20	....	....
Mean Pressure, corrected	29.890	29.669	29.670	29.724	29.821	29.795	29.854	29.888	29.914	29.965	29.718	29.907	29.818
Difference from Normal (eleven years)	+.142	-.085	-.044	-.001	+.111	+.035	+.087	+.109	+.065	+.144	-.010	+.156	+.051
Maximum Pressure	30.825	30.378	30.327	30.234	30.339	30.282	30.129	30.214	30.347	30.424	30.362	30.647	30.825
Minimum Pressure	28.827	28.683	28.676	29.122	29.296	29.320	29.436	28.889	29.306	29.309	28.716	28.898	28.676
Monthly and Annual Ranges	1.998	1.695	1.651	1.112	1.043	0.962	0.693	1.325	1.041	1.115	1.646	1.749	2.149
Highest Daily Mean Pressure	30.639	30.310	30.279	30.054	30.262	30.206	30.081	30.185	30.297	30.313	30.328	30.608	30.639
Lowest Daily Mean Pressure	29.376	28.801	29.161	29.228	29.345	29.409	29.549	29.207	29.437	29.483	28.817	29.166	28.801
Mean Pressure of Vapour	.122	.105	.142	.175	.236	.330	.466	.453	.371	.299	.165	.122	.272
Mean Relative Humidity	82.4	83.5	82.4	77.1	69.7	74.9	79.8	79.4	79.0	81.8	80.0	77.7	79.0
Mean Amount of Cloud	5.57	5.69	5.66	6.75	5.19	5.97	5.88	5.69	5.49	5.33	5.80	6.30	5.78
Difference from Normal (seven years)	-.72	-.40	-.16	+.40	-1.44	+.03	+.27	+.23	-.21	-.11	-.82	-.36	-.20
Prevalent Direction of Wind	N.W.	N.W.	N. W.	N. W.	N. W.	N.W.	S. W.	S.W.	S.W.	N.W.	N.W.	N.W.	N.W.
Mean Velocity of Wind	4.92	5.38	8.45	7.99	6.45	5.98	5.76	5.61	4.52	5.55	7.03	5.62	6.11
Amount of Rain	4.78	0.49	2.46	1.93	1.58	2.96	3.90	4.45	4.48	8.63	7.40	2.21	45.27
Difference from Normal (eleven years)	+1.02	-2.64	-.41	-1.06	-1.45	-.07	+1.39	+.76	+.72	+3.20	+2.47	-1.12	+1.99
Number of days Rain	9	2	8	12	11	17	16	11	12	14	10	8	130
Difference from Normal (eleven years)	+ 3	-4	+3	+2	-4	+4	+5	0	+2	+2	-2	0	+8
Amount of Snow	26.6	10.7	15.5	6.5	7.4	0	0	0	0	0	5.8	18.9	91.4
Difference from Normal (eleven years)	+10.0	-3.1	-3.0	-1.1	+6 6	0	0	0	0	-.5	+1.4	+1.7	+11.3
Number of days Snow	9	9	12	2	3	0	0	0	0	0	5	11	51
Difference from Normal (eleven years)	-1	+1	+4	-3	+2	0	0	0	0	-2	+1	0	+4
Total Precipitation	7 83	1.61	4.09	2.86	2.34	2.96	3.90	4.45	4.48	8.63	7.98	4.31	55.44
Difference from Normal (eleven years)	+2.15	-3.69	-.37	-1.02	-1.67	-.07	+1.39	+.76	+.72	+3.20	+2.56	-.55	+3.39
Number of Dry Days	15	18	15	16	19	13	15	20	18	17	17	16	199
Difference from Normal (eleven years)	-2	+2	-3	-2	+3	-4	-5	0	-2	-3	+2	+2	-6
Number of Auroras	3	4	7	6	10	4	7	5	4	4	1	0	55
" Gales	1	2	3	1	0	1	0	1	1	0	4	3	17
" Fogs	2	2	3	4	6	6	7	6	6	4	0	4	50
" Dews	0	0	0	2	6	5	15	18	19	13	3	0	81
" Hoar Frosts	10	8	12	9	5	0	0	0	0	6	7	10	67
" Thunders	1	0	0	0	1	1	3	2	2	0	0	0	10
" Lightnings	1	0	0	1	1	1	4	2	2	1	0	0	13
" Hails	0	0	0	1	0	1	0	0	0	0	0	0	2
" Rainbows	0	0	0	1	0	1	2	0	0	1	0	0	5
" Lunar Halos	0	3	2	2	1	0	0	0	0	2	1	3	14
" Lunar Coronæ	1	1	3	3	4	1	2	2	5	6	0	0	28
" Solar Halos	0	0	3	1	0	0	2	0	1	0	1	1	9
" Days Sleighing	28	28	15	0	0	0	0	0	0	0	0	18	89

noon—and clearing with wind veering W. in afternoon. On the 22nd we had snow in the morning. At 8 a. fine rain and sleet till 10.30 a; and occasional sleet showers and snow squalls p. m. A gale blew from S. E. early, and from S. W. to W. afternoon and evening. On 23rd it still blew very hard from W. S. W. and W. all day. Other phenomena were about their averages.

March still kept rather low in pressure. Its temperature was higher than usual, and presented a marked difference from the abnormal deficiency of heat in March 1872; being as 30.°09 to 22.°91; nor did the Thermometer touch 0—which it does in this month in two years out of three. The whole precipitation 4.09 inches was a very little below the average, but the deficiency happened both in rain and snow. Velocity of wind was much increased, with a general N. W. direction. The aurora was observed seven times and fogs three. Three times the wind reached a gale. On the 4th when, after nearly six inches of snow the preceding night with strong N. E. wind, it backed and blew from N. N. W. At 6h. 30m. of morning of 5th, the minimum thermometer registered 3.°8. On the 21st we had snow and sleet in the morning, and S. E. gale till 11 a., then heavy rain nearly all day. Height of gale was at 9 a., when it blew 32 miles per hour. Wind veered gently S. E. to S. W. between 6 and 7 p., but blew in S.W. gusts during night. Barometer was lowest at 6 p. Last sleighing on following day, on 22nd. On the 30th another gale was experienced, but not so strong. The wind was hardest from S. S. E. at 2 a. = 22.5 miles per hour. It gradually fell till 4 a. when it was quite moderate. The rain was heavy that morning from 1 to 5 a. Fog closed in from 9 to 10 a., and then the wind rose again from S. to S. W., blowing strongly all day with rain and snow squalls occasionally p.m. Cleared morning of 31st with W. breeze.

The mean pressure of April was as close as possible to the normal of eleven years, being 29.724, or but one-thousandth part of an inch below. The temperature also, 38.°07, was most regular; and only .05 below its normal. The N.W. wind still was in excess, and the velocity 7.99 but very little less than that of March—the most windy month of the year. But 1.93 inches of rain, which, with a snow fall of 6.5 inches, gave a total melted of 2.86 inches, being not 75 per cent. of the average precipitation. Six auroras, and only four fogs, and one gale were recorded. This storm began 12th, 10 p.m. and lasted till 2 p.m. of 13th, from N. E., S. E. and E., with rain showers. First Robins were seen 3rd. Dent de Leon cut 10th. Camberwell Beauty Butterfly at 10 a.m. of 12th. The N. W. Arm was completely frozen over on 18th. Full blown Mayflowers were plucked on 23rd. Swallows were seen 25th.

In May the pressure rose considerably above the normal; and the temperature was slightly above the average. N. W. winds prevailed; with comparatively small force from any quarter. There was again much deficiency in precipitation. Only 1.58 inches raise, or about half the average. While the extraordinary amount of 7.4 inches of snow fell this May—6.8 inches coming in one heavy fall on the 3rd;—but still making, when melted but 2.34 inches, together with the rain, and resulting as I have remarked in a large deficiency for the month. Ten auroras, six fogs, and six hoar frosts were marked. No gale occured in May—the wind never exceeding eighteen miles per hour. Latest snow fell on the 15th.

The June pressure was near the expectation of that month, being 29.795. The temperature was generally very low, and the mean but 55.°37 against 59.°27, the normal deduced from eleven years. Once more the N. W. was the prevalent wind, with a mean velocity from all directions of 5.98 miles per hour. The fall of rain 2.96 inches nearly touched the average of this usually dry month. We had four auroras, six fogs, no hoar frosts; but on the 3rd., the unusual event of a gale in June was noted; not strong, certainly, but still it blew hard from 6 a. to 6 p., and at 7.30 a. 21.6 per hour was read. There had been dashes of rain and hail the previous afternoon; and the pear tree had come into full blossom, among which much havoc was made. Apples blossomed on 8th. Horse chesnuts 13th. Lilacs 16th.

Again in July the pressure of the atmosphere deviated but little from the eleven years mean; being slighly in excess. The mean temperature was a good instance of how nearly correct the deduction of a normal from a long series becomes. 63.°48 being that result, and 63.°43 the mean of this July. The maximum of 87.°5 occurred on the last day, but the 22nd was the warmest throughout. Much more rain—3.90 inches—fell than in this usually dry month; and sixteen days were wet instead of the average eleven. The chief direction of wind at last changed to S. W., with a mean velocity nearly corresponding to that of June. No gale as usual; but seven auroras and seven fogs were recorded, with three thunder storms besides reflected lightning. Acacias blossomed on 22nd. New potatoes not in market till 30th.

In August high barometers for the season were noted. The mean rising .109 above the average. It was rather a cool month, though the maximum only fell short of that of July by .1, and the minimum of this month was 2° higher than that of its predecessor. The wind continued to prevail from S. W., with nearly the same mean velocity as during the whole summer. The 4.45 inches of rain were slightly in excess; but these twenty days of complete dryness, thus reaching the average of August in this particular. Auroral displays began to decrease, but four were observed. Twice was thunder heard and lightning seen. Six fogs occurred. We had one gale, which was much more violent in Cape Breton and the East, but here was strong through night of 24 / 25. At thirty-five minutes past midnight it was blowing 34.1 p. hour, and at 1 a. the corrected barometer stood at only 28.867. On 24th there was heavy rain early with thunder and lightning. Rain again heavy from 11.30 a. to 9.45 p., and light showers all night and during day of 25th. A N. gale began 24th, 6 p., veering N. N. E., very strong at midnight and continued 25th till 9 a. when declined; but the wind was very high all that day, backing to N. W. in evening.

September pressure was rather great, and the month was somewhat cool for the season; temperature rising however to 85° on the 28th, and never falling below 38.°5. Still S. W. winds predominated, with a mean velocity of but 5.52 p. hour—the least of any month in the year. The rain was almost identical with that of August, and again rather more than the average. Four auroras, six fogs, two thunders, two lightnings, and one gale were recorded. This latter was not remarkable and lasted but two hours from S. S. E., on the morning of the 5th. There were heavy showers early and again in afternoon with thunder and lightning, and fog and drizzle in evening. Wind veered through S.W. to W. during day.

The mean pressure of atmosphere in October rose farther above the normal, and was 29.965. The month was mild—more mild than May, to which its normal temperature closely approximates. On the morning of the 3rd, the first hoar frost of this autumn appeared, and on the 18th the temperature of air first fell to 32°. The prevalent wind returned to N. W., but with little velocity. Though quiet, the month was very wet; and the great rain fall of 8.63 inches was measured, being 3.20 inches above the mean fall, and 3.75 inches over the preceding October. Not a flake of snow fell this month. We had not one gale, which is unusual, though the same was remarked in 1872. Auroras, four. Fogs, four. Hoar frosts, six. And once lightning was seen, with the heavy rain of the 5th night.

In November the mean pressure declined greatly, falling to 29.718; which is, however, very nearly the average. Temperature also decreased to a remarkable extent, resulting in a very cold month. The mean was 33.°32, 4°.08 below the average. N. W. winds, as usual, prevailed; but not with a great velocity generally. Rain continued to fall in large quantities with 5.8 inches of snow; giving a total precipitation nearly equal to last month, and almost 50 per cent above the normal fall of November. One aurora, and seven hoar frosts, but no fog was recorded. Four times the wind rose to a gale, viz: 8 / 9, when heavy rain fell nearly all the former day and in showers in evening. Snow and rain and a S. gale at midnight, which veered S. S. W. and was at its height at 1 a. of 9th, and then fell early. On 13th when it blew from S. W. to W. S. W. in the morning, after snow, followed by heavy rain the previous day, with wind from S. E. to S. W. On 18th gale began from E. N. E. at 3 a., and continued through E. to S. E. till noon of 19th. On first day rain fell from 2 a. to noon, and on second snow began at 4 p., quickly turning to rain, which continued till midnight, when wind was very light from S. W. The fourth gale blew from 10 p. of 24th till 5 a. of 25th from E. S. E. to S. S. E. Snow beginning on afternoon, turning to rain at night, and ceasing at 6 a.

During the closing month, December, the barometer was frequently high, once even reaching 30.647; and resulting much above the normal. The temperature was slightly deficient in heat for this season. The thermometer marked below 0 as early as midnight of 15th, and at 1 a. next day the minimum of the month was touched—2°.9. The predominating wind remained N. W., and still the velocity was low. Rain was far below its average, and snow slightly in excess, the total precipitation not attaining the normal. We saw no aurora in December; four times fog, and ten times hoar frost were present. We had three gales. On the 4th, after a foggy noon and showery evening, a S. W. gale began at 8 p. The gale and rain ceased 5th 3 a., wind veered to W. S. W. On the 20th a snow storm began about 4 a. Rain and snow mixed fell during the forenoon, with E. S. E. gale from 9 to 11 a. On the 28th we had heavy rain and a S. gale in morning, and then wind veered through S. W. till the gale again sprang up from W. at 5 p. and blew till midnight.

The mean of the whole year 1873, was somewhat in excess in pressure of the atmosphere. The normal temperature of air in Halifax is 42°.92, derived from eleven years' observations. Last year gave 42°.24; being therefore rather a cool year. The mean pressure of vapour was .272, and relative humidity 79.0. The mean amount of cloud was 5.78, or .20 below the normal. N.W. winds greatly outnumbered any other, being the prevalent direction in nine months, (S.W. excelled in July, August and September) and observed 461 times out of 2920 observations. The mean yearly total of precipitation at this station, deduced from the same eleven years above alluded to, viz: 1863 to 1873 both included, is found to be 52.05 inches. Of this 43.28 inches fall as rain, and 8.77 are obtained from melting the snow, which normally falls dry to the depth of 80.1 inches. 1873 was a wet year in every respect, but not excessively so. 45.27 inches of rain fell on 130 days; and 91.4 inches snow on 51 days. 199 days were quite dry, or afforded no appreciable precipitation—205 being the mean number. Miscellaneous phenomena were observed as follows:—

Auroras	55	Gales	17
Fogs	50	Dews	81

Hoar Frosts	67	Thunders	10
Lightnings	13	Hails	2
Rainbows	5	Lunar Halos	14
Lunar Coronæ	28	Solar Halos	9
Days Sleighing	89		

The maximum temperature I know to be recorded here was 93°.1 on 9th August, 1872; and the minimum –15°.8 on 27th January of this year. In 1873 the highest was 87.°5 on 31st July, and the lowest –14°.4 on 30th January; giving an extreme range of 101°.9. The warmest day was the 3rd of August — mean 69°.54. The coldest the 30th of January—mean –2°.18.

ART. X.—OBSERVATIONS ON SOME FOSSIL BONES FOUND IN NEW BRUNSWICK, DOMINION OF CANADA. BY J. BERNARD GILPIN, B. A., M. D., M. R. C. S.

THESE bones were taken from one of the cuttings of the Intercolonial Railway on the Jacquet River, Bay de Chaleurs, New Brunswick. After cutting through sand and gravel for about twelve feet, a bed of clay was reached. In this the bones were bedded. Abundance of the following fossil shells were found with them:

Balanus hameri. Ascanius.
Fusus tornatus. Gould.
Buccinum undatum. Linn.
Natica groenlandica. Perry.
Leda truncata. Gould.
Mya arenaria. Linn.
Mya truncata. Linn.
Tellina groenlandica. Beck.
Tellina proxima. Brown.
Saxicava rugosa. Linn.

The cutting is forty feet above the level of the sea, and one-fourth of a mile from it, and on the north side of the river. The opposite or south side has the same exposure and fossils. The clay is postpliocene and of the Lake Champlain period. I am indebted to my friend Dr. Honeyman, who visited the Jacquet, for these facts.

The fossil bones consist of eighteen vertebra, a small portion of the atlas, about twelve fragments so thick and so marked by nearly obsolete sutures, as to prove them portions of the base of the skull, the petrous portion of one ear, about one-half of the lower jaw, a fragment of the sternum, fragments of both scapulas, one humerus, radius ulna and phalanx, one or two ribs, and numerous fragments of ribs, and spinous processes of vertebra. They are entirely free of animal matter, of a light fawn color and so dry or chalky as to leave a dusty mark upon everything they touched. From comparison with some of the recent bones in the Halifax Museum of some of the smaller Cetaceans, and with the beautiful plates of the bones of the Boston whale, (B. musculus) by Dr. Dwight, Boston N. H. Society, there can be no doubt but that they are the remains of some ancient small Cetacean inhabiting the Champlain clay period.

Of the eighteen vertebra, four are dorsals, ten lumbar, and four caudal. The four dorsal are all more or less incomplete in the neural arch, and transverse processes or diaphophices. The largest one measures in its centrum or body, two and three-fourths inches transverse section of articulating surface, and two inches in length. The height of the neural arch is one inch and three quarters, and two and one-half breadth of the floor of the arch. The spinous processes in all are incomplete. In all these four, the diaphophices or transverse processes spring from the sides of the neural arch, above the body of the vertebra, but each one a little lower down than the one preceding it. The ends of the processes show strongly marked articulating surfaces for the ribs.

Of the fourteen remaining, ten may be considered lumbar. The largest measures four inches long and three inches transverse diameter. They are all deficient in neural arch and transverse processes, but from a depression on the upper surface you can make out the floor of the arch. This in the largest one measured, measures only an inch and a half transverse diameter, whilst in others nearly of the same size, but lower down in the series, it measures only half an inch. From studying, what of course must be a very broken series of the remains of transverse processes, we can make out a general principle, that as in the dorsal they spring lower and lower from the neural arch, so also in the lumbar, they spring lower and lower from the body of the vertebra until they become lower than the centre of the vertebra itself. Thus the neural arch with the spinal cord runs slightly oblique to, rather than parallel with, the line of transverse processes. Of the four remaining caudal vertebra, two only have a small process to mark the transverse process, but they all have a slight depression in the upper surface, making the floor of the neural arch, and chevrons from the lower surface. These chevrons though much decayed, have remains of a double process, projecting like two horns from the anterior articulating surface of the vertebra, into which, evidently, a single process from the posterior articulating surface of the vertebra next preceding it had fitted. The smallest caudal vertebra measured one and one-half inches in length, with the long diameter two and one-half inches. There were many fragments of bones composing the base of the skull, with marks of sutures, a petrous portion of the bones of the ear, and about one-half of the right jaw, the latter well preserved.

This fragment measured three and one-half inches in length and two inches in depth. There were three large neural foramena and the symphasis showed that it was blunt or round, and that there were small teeth about half way down the jaw from it. There are a few fragments of spinous processes which show that at their anterior roots were processes pointing forward. A fragment of the sternum remains, nine inches long, irregularly triangular, and having on its left side very deep marks of articulation with the ribs. It is slightly convex on its external surface, and slightly concave on its internal surfaces, and was evidently much longer. The fragments of both scapulas remain. They are unevenly convex on the external, unevenly concave on the internal side, but very flat, with no spinal ridge. The acromion and coracoid processes are well developed, but upon the same plane as the large humeral articulating surface. From the fragments, it seemed that it had resembled a pole-axe, the head being the cavity for the humerus. The humerus is very complete, with the head large, the shaft short and thick, and the muscular marks and processes very bold. It has two articulating surfaces at the lower end for the ulna and radius. Its length was four and one-half inches, and breadth at the head two and one-half. A very perfect radius, broad and flat, with a convex anterior, concave posterior edge, and two articulating surfaces at its lower extremity, length four inches, breadth one inch and a half,—a fragment barely enough to show it to have been an ulna, its olecranon gone, and one small phalanx completed the bones of the upper extremity. Of the very numerous fragments of ribs, but two or three remain so entire as to show their original shape. Their articulating surfaces both vertebral and sternal are large, an appearance of neck longer or shorter is in all, and whilst one of the shortest or sternal measures nine inches, the largest or abdominal with a very flattened extremity measures two feet.

From comparing these bones with recent specimens of Cetæ both Delphinus and Phocenæ, in the Halifax Museum, and with the excellent plates of B. Musculus, by Dr. Dwight, Boston Natural History Society, there can be no doubt that they are the remains of a small Cetacean. The fragment of the lower jaw so exactly resembles the cut in Dana's Geology of Beluga Vermontana, as to hazard the conjecture that they are closely allied, if not identical, with its remains found also in the same deposit but many miles distant. We also notice the want of parallelism between the line of spinal cord, and that of the diapophises, which is shared also by a recent skeleton of a Delphinus in Halifax Museum,—the process projecting forward from the root of the spinous process, which also obtains in the recent Delphinus where it anchyloses with the preceding spinous process—the peculiar articulation of the chevrons and the want of spinal ridge in the scapula, this ridge first appearing in the Dudongs or herbivorous Cetæ, which, singularly enough, has pectoral mammæ instead of abdominal, and in suckling clasps its young to its bosom.

Of the age of these bones as they were found in the Champlain clay deposit, or that period when the river terraces were formed, we may infer that he had lived and died in some ancient ocean, from which the present ocean level has receded, or its bed has been elevated, and then the sands and gravels and clays of the terraces heaped above his remains,—that he was a fossil, unchanged and undisturbed, centuries perhaps before the Mastodons and Mammoths, whose bones were found in the peat deposits of N. America, including the tooth and thigh bone found in Cape Breton, which has been referred by Geologists to the later genus, had begun their existence.

Art. XI.—Agriculture allied to Chemistry. By A. P. Reid, M. D., L. R. C. S., Edin., &c.

(*Read before the Institute Dec.* 9, 1873.)

In taking up this subject, I do not expect to give anything new, or broach any form of theory, but rather to give a resumé of the previous and present ideas that to a great extent rule with those who have paid most attention to the scientific cultivation of the soil.

Previous to the present century these sciences were held to have but few links in common, the authorities in either, with few exceptions, did not trespass their imaginary boundary line. Even Sir Humphrey Davy in his lectures on the "Elements of Agricultural Chemistry," (1802–1812), did but shew that there was a relation between the *science* of Chemistry and the *art* of Agriculture.

Strange to say Boussingault, in 1836, after long study, experience and observation, came to the conclusion that the value of manure was to a great extent indicated by the amount of nitrogen and ammonia it contained—a theory that was rudely shaken to the winds by the accomplished Liebig; but it has again asserted itself, and is not likely to be displaced, for experience has proved the security of its foundation, and the accuracy of the study and observations of its founder.

In 1840 Liebig propounded a most comprehensive, clear and definite theory of plant nutrition that took the agricultural world by storm and ruled for years, but it vanished, and was even given up by its illustrious founder, long ere his late decease. I will very briefly run over its landmarks, for it had much to do with the extended and accurate observations of the past thirty years.

The old idea, advocated by Sir H. Davy, was that plants derived their gaseous nutrition (carbon, hydrogen, nitrogen, and oxygen) from *humus*, a constituent of all productive soils. Boussingault taught that plants obtained these elements both from the air and soil, but could not solely depend on either source for their requirements. That notably the nitrogen and ammonia in the air had to be supplemented by these substances if not existent in the soil.

Liebig taught that the food of the chief mass of the plant (carbon, hydrogen, oxygen, nitrogen) consisted solely of carbonic acid, water and ammonia. That these were altogether obtained from the atmosphere, which was abundantly supplied by the decay of animals and vegetables, their decomposition giving off these substances to the air. That thus is produced much more oxygen than plants can use, and hence this gas so absolutely necessary for the maintenance of life had its supply kept up by plant growth. The decomposition of carbonic acid depositing carbon in the tissue of the plant and giving off oxygen to the air. That the only substances furnished by the soil were the "ash constituents" of the vegetable, or the mineral matter it contained. That these alone were all that were necessary to be supplied to the land, as they were all that were taken from it. That manures were only of value in proportion as they contained the mineral or ash constituents of the crops they were intended to nourish.

All of these ideas of Liebig are yet believed to be and are correct, the only error being that they were made too exclusive. Plants do absorb and assimilate carbonic acid, water and ammonia from the air, but they require a portion from the soil as well, and hence manures containing these, or equivalents, are demanded.

The ashes of the plants or mineral constituents are derived from the soil, in which they must exist in a state capable of being dissolved in water, and there is need for their return in this form to keep up productiveness. In this particular a good soil is an extensive deposit that may be drawn on for many, many years, without showing very marked deterioration. For good husbandry exposing it to the air, causes the insoluble salts of silica, potassa, lime, phosphates, &c., to be decomposed, and in addition much ammonia is absorbed from the air and retained, this being a property of all well tilled soils. The other gaseous or aerial constituents, and a large portion of the nitrogen are not so renewed, and hence need the most frequent repletion and must be furnished in the largest percentage by the most profitable manures. In fact we have returned to the previous theory of Boussingault.

The ash of plants contains potassa, soda, lime, magnesia, iron, phosphoric and sulphuric acids, silica, &c., &c., derived from the soil. Liebig taught "supply these in a soluble form in sufficient quantity and the plant demands nothing more in the way of food; with these it is able to assimilate carbonic acid, water and ammonia from the air, without them it cannot." Liebig's "Mineral Manures" were the natural outcrops of such teaching,—much was expected from them, but comparative failure resulted.

Farmers voted sientific agriculture a delusion and returned to the good old way that had been handed down from father to son for ages, and yet they could see that their lands were getting run out though knowing not how to correct their condition.

No country demands more from its soil than Great Britain, and no people are better qualified to reduce theories to a financial basis; hence it is natural that we should look to England for correct practical as well as scientific agriculture. To get the grains of truth out of the mass of chaff abounding in all theories, and as well to still farther enlarge the domain of our knowledge, an experimental farm at Rothamsted, England, was carried on for over 20 years (from 1843 to 1864, when reports were given) by Lawes and Gilbert. They gave to the world the most practical and scientific agriculture that had yet obtained, and whose results stand the test of continued experience. Every conceivable theory and experiment was tried and the results given in plain and explicit figures and opinions. To these as I am able to understand them, and as briefly as possibly, I would wish to direct your attention.

Continued crops of the same kind without manure and from the same soil, exhaust the soluble ash constituents demanded by that plant and as well the organic elements it requires for food, and that are present in more or less quantity in all soils.

Rotation of crops is good husbandry, because different plants require different mineral food, and a soil deficient for one plant may have abundance of what is wanted for another. The waste of one crop that decays on the land or is returned as farm yard manure furnishes food for the one that follows, and the tillage, by exposure of the minerals of the soil to the air and sun and rain, promotes their decomposition and consequent solubility, while facilitating its power of absorbing ammonia from the atmosphere. In this way is utilized a portion of the vast reserve of minerals or ash constituents present in all soils, the soluble part of which had been more or less removed by previous cropping.

Regarding the influence of manure, it requires some variation owing to the kind of crop, and different manures are suitable at different stages of the growth of the same plant. Phosphoric acid, potash and ammonia are largely demanded by all crops, and soils are most rapidly exhausted of these constituents.

Farmyard manure is the most universally applicable, but its supply is very limited in proportion to its demand. It can be aided or even supplemented by the judicious use of substances containing nitrogen, such as guano, sulphate of ammonia, nitrate of soda, rape cake, &c., and those containing phosphoric acid, such as apatite, coprolites, bones or animal matter, superphosphate of lime, mixed phosphates containing lime, magnesia, potash and ammonia, as in "artificial" manures, guano, and those containing potash, as the ashes of plants.

Wheat and cereals demand a very large proportionate amount of ammonia and next of phosphoric acid—silica, lime, etc., being generally present in sufficient quantity. Potash is also largely supplied by most soils.

Turnips and root crops, though having as large a percentage of nitrogen as cereals, and also the marked property of absorbing ammonia from the atmosphere, and thus getting a quantum of nitrogen, do not require it so much as manure. It is very serviceable after the plants have attained a vigorous growth, and should be combined with carbonaceous manures and placed not too near the seed, as their presence is prejudicial at an early stage, though most necessary when approaching maturity for the development of the weight of the bulb. The soluble phosphates are the most demanded by turnips and root crops at an early stage of growth to promote active development, but are not needed as they approach maturity for they do not increase the weight of the bulb.

Phosphates alone used as manure are not successful. The amount of phosphoric acid in the turnip crop is not larger than it is in the wheat crop, yet experience teaches that a direct supply of soluble phosphates is more influential in promoting the growth of the turnip than wheat, and hence they must exercise some important function in its development.

To give an idea of the amount of material obtained by crops from the soil as minerals, and the amount of soluble mineral or ash constituent present, and that obtained from the air and soil as gaseous or aerial, or as often termed organic constituents, I present a table which I have compiled from those given by Magnus and Lawes and Gilbert,—and as well as analysis of the soil. The quantity of each constituent is given in pounds weight, and they exist of course in combination though spoken of as in the free state. Straw and grain are included in the analysis.

	Phosphoric Acid.	Potash.	Lime.	Magnesia.	Silica.	Totals.	Nitrogen.	Dry Crop.
Per acre of soil one foot deep, soluble in acid—lbs......	7581	8983	35794	10180	17920	80468	10	
Average annual Wheat crop (35 bushels), lbs. per acre....	3–73	12–73	4–72	1–89	61–3	94		
Wheat 30 bushels per acre—lbs.	23	29	9	6	102	182	51	4080
Barley, 40 " " "	20	30	12	7	88	171	50	3891
Oats, 44 " " "	16	31	12	8	90	184	56	3515
Beans, 34 " " "	29	52	32	11	6	102	113	3777
Turnips, 10 tons " "	20	89	60	4	8	289	77	2957
Clover, 5000 lbs. per acre	28	75	121	32	11	373	124	4150

In no part of the Dominion are correct ideas of the chemistry of agriculture more needed than in Nova Scotia, where many farms are quite run out. I have seen thousands of acres lying waste in different parts of the province, and on enquiring the cause from those in the vicinity they said, "the land was spent and not worth the trouble of tillage, though it had at one time been good."

The rotation of crops and manures which obtain in England are not on that account necessary for Nova Scotia, but the principles which dictate and the occasions which demand rotation are precisely the same. The composition of our soils may vary from those of Great Britain, but good tillage and judgment in the selection of appropriate manures for plant food are as necessary for the one as the other.

To assert that Nova Scotian farms want the same manures and crop rotation as Rothamsted would be haphazard, but to say that our farms want as good tillage and as careful experimenting is simply a statement of fact.

The soils of Nova Scotia are extremely varied, and their chemical analyses are not alone sufficient upon which to build a perfect system of agriculture. Because though chemistry may give all the constituents in their natural state of aggregation, it cannot positively state the influence on each of tillage and exposure to the air with the acquired solubility of its minerals. However it can suggest the most likely experiments to be tried in the way of manures and crops.

A rotation of crops applicable to most soils is the alternating of cereals with roots, vetches and clover, as these possess marked superiority in absorbing ammonia from the atmosphere, and as well of assimilating the nitrogen, and thus enrich the soil for a grain crop by the products of their decay, while their accompanying tillage has increased the soluble minerals from the vast insoluble reserve that makes up the mass of clay and sand and loam to which we give the general name of *soil*. Careful and intelligent agricultural experiments by the agricultural societies on the granitic, plaster, and alluvial soils of our province, would before many years bring unwonted fertility to our farms, and the demand for manures, whether phosphatic or ammoniacal could be freely supplied by the resources of our own province.

There is an old and very erroneous saying that "any kind of a man is good enough to make a farmer of," but even limited experience will convince that there is no human calling that can give as good and continuous return for the capital and intelligence invested, as the farm. I could not say to Nova Scotian farmers buy a book and immediately set to work on what is wrongly styled *scientific* farming, for failure would be the probability. But rather study up the best authorities on agriculture, and set apart five or even one or two acres upon which to experiment with all varieties of crop and manure that would hold out prospects of success. Thus there would be no fear of incurring any serious loss or disappointment. It takes energy and patience with study both of chemistry and agriculture to make a good experimenter on a plot of one acre, and this method alone when thoroughly and repeatedly worked out can give success on the more extended area of the farm.

Young men designing to enter on an agricultural career would need to devote as much time to education if success is to be assured, as would be needed if they intended adopting the professions so called. For it is an extensive and complicated subject, and can give scope to the most accomplished intellect in studying its mysteries.

Chemistry does and will do much for agriculture; it explains the changes taking place in and products resulting from vegetation; it gives, in competent hands, the composition of the active constituents of the soil and suggests the most appropriate additions thereto, or in other words directs EXPERIMENT, the crucial and TRUSTWORTHY TEST.

When the demand becomes sufficiently extensive for commercial success, it will produce the necessary plant food in soluble form from apatite rock, phosphates from the so called *marle* deposits existing in the province, from the bones and animal substances that now go to waste, from ammoniacal gas liquor, sewage, sea weed, and such like, that are mines of wealth to the farmer as well as manufacturer, when the occasion calls forth some of the resources of Chemistry.

ART. XII.—EVOLUTION. BY ANGUS ROSS, ESQ.

EACH animal* begins life at the same point of departure—the egg—with every other, and certainly all the *Vertebrata*, in the early stages of their development, pass through apparently precisely the same transformations, but all except man at some stage become specialized: he alone continuing a course of harmonious develop-

* Except certain of the lower Grades in which a whole community is developed from the product of a single egg, by budding, subdivision, &c.

ment until arriving at maturity; and all that is known of the animals that have existed on the Earth indicate that the metamorphoses, which each mature animal now living has undergone, (in its individual development,) are types of the changes which have taken place in the Kingdom, Sub-kingdom, Class, Sub-class, Order, Sub-order, Family, Sub-family, Genus, Sub-genus, Species, Sub-species, Variety, and Sub-variety, to which it may belong.

The distinctive peculiarity of existing animals as compared with those of past Epochs, therefore, is that their organization is more specialized, so that as we go backward in time the distinctive peculiarities of the natural groups gradually disappear, intermediate forms and increasingly generalized or "synthetic" types continually appear, bridging over apparent chasms. Thus the Genera *Equus* and *Elephas*, each consisting of but a few existing Species and widely separated from each other, and from every other Genus of living animals, are found to be in close relation with many allied and intermediate forms, the remains of which are found in the rocks of the Recent, the Quaternary, and the Tertiary Periods; the types becoming more and more synthetic as we go backward in time, and the relative size of the brain cavity gradually diminishing, until in the earliest Tertiary it becomes comparable to that of the Reptilia. The most remarkable differentiation in the Equine family is in the structure of the foot; passing gradually from the four toed Genus *Orohippus* of the Eocene, through such intermediate forms as the three-toed genus *Anchitherium* of the Miocene, and *Hipparion* of the Pliocene, which had three toes, but only the middle one well developed, the other two not reaching the ground, to its present representative Equus, including the Horse, Zebra, &c., with its single toed foot.

Birds are a highly specialized Class of *Vertebrata*, having however closer structural affinities with the *Chelonia* than would be supposed from external appearance. One of their marked peculiarities is that they are all toothless. Few remains of the earlier Birds have yet been found, but among them is *Ichthyornis dispar*, of the Cretaceous Period, which shews a complete set of teeth! The embryo of certain living Birds also have teeth, thus illustrating the law that the metamorphoses which the existing individual undergoes are representative of those which the group to which it belongs has undergone. In other respects *I. Dispar* had well marked Reptilian and even Ichthic characteristics, in other words was of a very synthetic type. The *Archæopteryx macrurus* of the Jurassic Period had, in accordance with the same law, still more marked Reptilian characteristics.*

Of all Vertebrates the Sub-class Amphibia is the most obviously suggestive and instructive in the metamorphoses which it undergoes after leaving the egg, shewing, in the common Frog, for example, how a creature approximating to the typical organization of the earlier Fishes, living only in the water, breathing by means of gills, subsisting chiefly on vegetable food, without limbs but with a muscular system adapted to use the tail in swimming as the sole means of locomotion, develops into an Amphibian without a tail, possessing true limbs of indeed remarkable homological symmetry, well developed lungs and voice, all the change in the circulation of the blood implied by the presence of the lungs, and all the great changes in the muscular and other systems of organs implied in the use of well developed limbs and in making insects its only food, while other Families of this same Class illustrate, in the mature condition, almost every stage of the process by which so great a change is accomplished. Nor can it be without a deep significance that in all the higher Vertebrates—in Man himself, somewhat similar metamorposes take place in intra-uterine life—the embryo having gills (not fully developed) before it has lungs, although as the blood is not aerated within the embryo they can have no direct use.

All Vertebrates are Quadrupeds, and each limb, if complete, has five digits, but while in the *Ungulata* many have but two well developed digits to each limb, and in the Equine Family all but one have become atrophied, in the Order Ophidia, the limbs are completely atrophied and functionless (with rare exceptions), and not

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* The tail is 11 inches long, and 3½ inches broad. It consists of 20 vertebræ, and has a row of feathers along the sides. These few feathers are in pairs corresponding with the number of the vertebræ, and diverge from the axis at an angle of 45°; the last pair extends backwards nearly in a line with the last vertebrae, and 3½ inches beyond it. The wing appears to have a two jointed finger. The breadth of the wing was made by feathers as in birds, and not as in a Pterodactyl by an expanded membrane. The feet are like those of Birds.

apparent externally, that Order being in this as in the "vegetative repetition" of vertebrae, the most asymmetrical and specialized of the land Vertebrates, so that the poison bag possessed by some of them, was scarcely needed to make the "Serpent" the fitting emblem of Evil in every Mythology. In accordance with the general law which I have indicated, this highly differentiated Type does not appear among the early representatives of the Class, not having yet been found earlier than the Cretaceous Period.

The remains of Fishes, the lowest and earliest, the most numerous and the most various or differentiated Class of Vertebrates, are found in rocks of the latest Silurian Epoch (and upwards), of two Orders, the Selachians or Placoids, and the Ganoids. The first of these, of which the Port Jackson Shark is one of the best living, representatives, was approximately homologically* symmetrical, had an internal cartiloginous skeleton, and was covered externally with shagreen or roughened skin, protected by a spine at each fin, and had teeth consisting of broad bony plates, somewhat similar to those which formed a complete bony external skeleton in the only other then existing Order of Fishes—the Ganoids. These last were less symmetrical than the Selachians, and although at first the internal skeleton was cartalaginous, yet afterwards in the Devonian the *Coccosteus*, has the internal skeleton osseous in the jaws and vertebræ, and afterwards other families have internal skeletons still more ossified. The *Coccosteus* and *Pterichthys* Families are remarkable as being the first examples of asymmetry, by the limbs being functionless, the former having no apparent fore limbs, and the latter no hind ones. The Teliosts, or Fishes with true bony skeletons and covered with scales externally, appear for the first time in the Cretaceous Period, and are the predominant Type among living Fishes. Some existing Families have no functional limbs, while others are distorted in the most remarkable manner. Thus the Flounder, as also the Plaice, Halibut, &c., "is twisted half around and laid on its side. The tail too is horizontal. Half the features of its head are twisted to one side, and the other half to the other, while its very mouth is in keeping with its squint eyes.

* Man being taken as the type.

One jaw is straight and the other like a bow, and while one contains from four to six teeth, the other contains from thirty to thirty-five."

It is interesting to note the development of true teeth among the oldest, so far as is known, of Vertebrates—the Skarks, for while the earliest had pavement teeth—broad plates like the dermal plates of their contemporaries the Ganoids, other Families of Sharks in the Carboniferous had narrower and sharper teeth, while in some existing Families they are quite sharp. In the Ganoids the dermal plates vary much in character and disposition. Some of them had pavement teeth. The Sturgeon, an existing Ganoid, has no teeth. Most Ganoids since about the close of the Palæozoic Period, have shortened and bilobed or hetrocercal tails when mature, but when young have homocercal tails, like the ancient Ganoids. The *Pterosauria*, higher *Batrachia*, later *Aves*, higher *Simiadœ*, and the *Anthropidœ*, have the tail completely atrophied.

The Teleosts deposit their spawn before fecundation takes place, while the Shark is in fact placental, bringing forth its young in a well advanced condition. Other existing Orders, of which however there are but few living representatives, show how exceedingly varied and wide in its limits is the organization of Fishes, for while the "Mud Fish" has a heart with two auricles, external rudimentary branchiæ, internal functional branchiæ, and *true lungs*, being thus much above the ordinary level of Fishes, the *Amphioxus lanceolatus* has no heart but only contractile arteries, no kidneys, a sac like liver, no vertebral arches, no distinct brain, no auditory organs, neither a cartilaginous nor an osseous skull, nor a mandible, nor any limbs, and even the Order represented among living Fishes by the Lampreys and Hags, though much more highly organized than the last mentioned, seem devoid of any indurated tissue. And here I would remark the great imperfection of the Geological Record, since generally speaking only highly indurated tissue could be preserved, and thus whole Orders, even, of Cartilaginous Fishes have probably perished, leaving no fossil trace, and if they should happen to have no living representatives, as is known to be the case with some Orders among the Reptilians, then no definite record of their existence may now remain. And if whole Orders have no fossil representative, because devoid of well indurated tissue is it not probable that the earliest representatives of some existing Orders may have left no remains, especially as we have seen that the earliest fishes were devoid of any internal indurated tissue, and in the case of one of the earliest known Orders the Selachians, there was not much well indurated tissue in the exo-skeleton ; so that it is probable that it will ever remain impossible to trace back the various Orders of Fishes until they approximate so closely as do the earliest known representatives of the *Sauropsidia* or the *Mammalia*.

The *Labyrinthodontia*, an Order of extinct Amphibians which flourished abundantly throughout the Carboniferous Period, combine characteristics of existing Orders of Amphibians with those of the early Ganoids, while the *Ichthyosauria*, the *Plesiosauria*, the *Pterosauria*, and the *Dinosauria*, are extinct Orders of Reptilians, which connect together the various Orders of existing Reptiles, and these again with Amphibians on the one side and birds on the other, so that all non-Mammalian Vertebrates are thus connected, and considering how imperfect the Geological Record as now known is, not only from its necessary imperfection, but also from the limited character of explorations yet made, enough is known to suggest, if not to warrant, the opinion that originally the differences were only "Generic" or even "Specific" in value.

The interval which separates the non-Mammalian Vertebrates from the *Mammalia* as found on the great Continents, that is Asia, Europe and Africa, is wide indeed, for of the three Sub-classes into which, from their structure the *Mammalia* are naturally divided, only one—the farthest removed—is found there, the *Monodelphia* or true *Mammalia*. Of the two remaining Sub-classes *Didelphia* or *Marsupialia*, and *Ornithodelphia*; the first, though once abundantly represented on each of the Continents, is now nearly extinct in America, and is found abundantly represented only in Australia, where its isolated position has protected it from the results which elsewhere have followed its contact with the more differentiated and with the more highly organized tribes of the greater Continents ; and it is here also that the surviving representatives—the *Ornithorhyncus* and the *Echidna*—of the *Ornithodelphia* are found.

If the interval separating the *Marsupialia* from the *Sauropsidia* seems insufficiently bridged by the two Genera, only, which are known of a single Order, the *Monotremata*, the only surviving Order of the Sub-class *Ornithodelphia*, it should be remembered that every principle of analogy would lead us to anticipate, that when that Island Continent shall have been well explored geologically, the remains of other Genera, Families, and even Orders will, as in the case of the *Ganoidea* and *Labyrinthodontia* among the *Ichthyopsidia*, restore to us the connecting links which in Mesozoic Periods gave an easy transition from the *Sauropsidia* to the *Mammalia*.

Of *Mollusca*, the Tetrabranchiate Cephalopods, of which the Genus *Nautilus* is the only living representative, possesses some points of very special interest, as having chambered shells and continually moving outward as they grow, the shells, which have also the very great advantage of being exceedingly well preserved as fossils, present an epitome, perfect, so far as it goes, of the entire life of the individual; so that there exists a singularly well preserved representation of the entire Order,—from its apparent origin in the Lower Silurian to the present day, when it has almost become extinct,—alike as regards the successive Species and the successive phases in the development of the individual of each Species. *Orthoceras*, of the lowest Silurian Epoch, the earliest and simplest known type, had a shell in shape a straight cone, and had simple concave septa. It was followed by such forms as *Cyrtoceras* and *Phragmoceras*, with shells resembling a bent cone, and with septa having shallow lateral lobes. After these comes *Gyroceras*, in which the bending of the shell has so much increased as to give it the form of a loose coil, and in which the lobes have become deeper, followed by others in which the coil has become close, and the latter lobes more angular, until the shell has become involute and the umbilicus has been obliterated, as in *Nautilus ziczac*, of the Tertiary, and the living representatives of the Family.

The Ammonite series, in which a similar succession of forms occur, are remarkable for complication of their septa and the profusion of their ornamentation at the time of the Jurassic Period, when they had the greatest number of Specific forms. But this is true only of the adult individual, for the earlier stages of the life of the individual represented accurately in a modified form, the earliest Species of the Series to which it belonged taking on successively the characteristics of the successive Species of such series until it arrived at maturity; in the keeled group changing from four rounded to eighteen foliated lobes, and in form from an open coil to a completely covered umbilicus, while in regard to ornament it takes on the characteristics of the Series to which it belongs in regular succession during the successive stages of its growth: "In other words there is an unceasing concentration of the adult characteristics of lower Species in the young of higher Species, and a consequent displacement of other embryonic features which had themselves, also, previously belonged to the adult periods of still lower forms." While the shell-covered Tetrabranchiates, have long been continually decreasing in numbers, in specific forms, in size and in ornamentation, the naked Dibranchiates, rival in size the largest of the extinct Tetrabranchiates, or the largest existing Fishes or Reptilians. Many existing Dibranchiates (such as the Cuttle fishes and Squids) have an internal skeleton or osselet, either calcareous, horny or membranous. The *Connularia*, fossil osselets, which occur from the Trenton Epoch (of the Lower Silurian) to the Liassic Epoch (of the Jurassic Period) inclusive, are still abundant and are represented at present by such huge forms as *Megaloteuthis harveyi*, the oldest remains of the Dibranchiates; but since only the osselets are preserved it is plain that if the earliest Cephalopods, like the earliest Fishes, had no indurated internal skeleton, (and we know that in the Calamaries it is often not calcareous and that the *Octopidœ* are destitute of it, and the shell is represented by two small rudimentary stylets encysted in the substance of the mantle), they may have existed abundantly without having left any definite traces. It is for a similar reason, doubtless, that the Ascidians though their structure would seem to indicate that they had a very remote origin, have never been recognized as fossils. Indeed it is probable that up to the time—the Devonian Period—when the highest of the then existing *Ichthyopsidia* began to have osseous tissue developed in their internal skeletons, no internal indurated tissue ever existed in the highest or central type of any

Epoch, and it is probable that such highest type was always naked, or nearly so as at present, but possessed teeth, pavement or plate like at first, but gradually acquiring the more differentiated forms since the later Silurian Epochs. Now if this were so, it satisfactorily accounts for the fact that previous to the time of the Fishes with an exo-skeleton in part at least osseous, no animals so far as known, at all approaching to homological symmetry in type, have left recognizable remains; and that while the early Ichthiopsidians (in their grade) of remarkably homological symmetry, are well represented, the earlier (and more homologically symmetrical) representatives of the various Orders of the *Sauropsidia*, and of the *Monotremata* aud *Marsupialia*, and of the true *Mammalia*, until the beginning of the Tertiary Period, are so very sparsely and imperfectly known to us, is doubtless due to the fact that these last inhabit dry land and could only be preserved when some accident burried their remains in strata of such a character as would preserve them, so that not one of them would be preserved for every thousand that would be preserved of the marine Species. It must also be remembered that they were probably much more limited as to habitat and numbers. Doubtless similar reasons account for the comparative scarcity of fossil remains of *Quadrumana*, known to have existed throughout the Tertiary and Post-Tertiary, and of Man, known to have existed in Britain before the last Glacial Epoch there, and in France during the Epoch characterized by the existence of the cave bear. It should be well understood that Man differs physically in no way from the other Mammals, except that he is more advanced and is the central and only completely symmetrical existing type.

With regard to the other Orders of Mollusks, I will only remark that all the marine types are, at an early period of their development, free swimmers and possessed of functional eyes, although many afterward become sessile, and many blind before they reach maturity. And if the land Species do not so apparently exhibit this phase of development, it is because they pass through the corresponding transformations before leaving the egg.

The *Pteropoda* which swarm about the great banks of floating seaweed of the mid-Atlantic, and form in the open seas of the

North the food of the Whalebone Whale, represent (approximately) in their adult form the free swimming stage of the *Gasteropoda.*

The *Tunicata* (Ascidians) perhaps the most synthetic type known to us among the *Mollusca,* are remarkable as containing the proximate principle, cellulose, the basis of *vegetable* structures, and also as being, perhaps, the highest type of animal life in which individuals are reproduced by *budding,* so characteristic of the *Radiates,* both animal and vegetable. They have also peculiarities of structure which ally them with *Amphioxus lanceolatus,* the lowest known Vertebrate. The lowest known Genera of the *Tunicata* are the *Appendicularia,* resembling a tadpole externally, and swimming freely by means of the tail. These when mature represent the immature forms of the higher *Tunicata,* before they become fixed or attached to rocks and their tails are absorbed; thus shewing the same tendency to shortening of the caudal extremity which is found in the higher and later representatives of almost every organic type. The *Appendicularia* then at the base of the *Tunicata,* are perhaps the most synthethic of organic types having structural peculiarities which ally them to the *Vertebrata,* the *Mollusca,* the *Articulata,* and the *Radiata,* through the lowest types of each of these respectively.

The common Ant, after reaching the three stages successively, in which it represents the three classes of *Articulata*—*Vermes, Crustacea,* and *Insecta*—loses its wings before it begins to find food for itself or for the community. To what purpose then does it possess so exquisitely complicated an apparatus by which it sports for a few hours in the sunshine only to have its wings dried up and destroyed, thus not only losing any advantage from the expenditure of vital force necessary to the production of wings and muscles, nerves, &c., necessary to use them, but also exposed to all the dangers of becoming the prey of insectivorous creatures while on the wing and afterwards, before being cared for by the parent ants, or of being carried out of reach of the community by the winds, &c.? To what purpose unless it be merely because it is impossible for it to reach its adult condition except through those phases which characterized the adult condition of its predecessors, just as all Vertebrates are furnished at one time in their development with gills, though at the present day only the lowest Classes have any use for them, and many of the Amphibia only before reaching the adult state. In succeeding Species of Ants the wings may become embryonic and functionless.

In the *Radiata*, the planula (egg) of the Polyp, the Jelly-fish, and the Star-fish, (representing the three chief divisions) are quite similar, and in its early development a jelly-fish resembles a polyp, while a star-fish passes through stages in which it resembles first the polyp and then the jelly-fish.

The earliest (and lowest) known representatives of the Echinoderms were the Crinoids, whose remains are found abundantly in every formation from the Lower Silurian to the present day, when they are represented by such Genera as *Pentacrinus*. All existing Echinoderms pass through a Crinoid stage, and the higher and later Families pass through grades, representing the lower and older successively until they attain their own proper grade at maturity, when reproduction by the production of planulæ occurs. In *Pentacrinus*, again, the individual, after reaching its Crinoid stages, passes through stages representing successive crinoid Genera leading up to itself.

The mode in which most individuals of this Class are produced, not by direct development from the egg, but by budding from other individuals, so that a whole community has its origin in a single egg, shews that in this as in some other respects the Radiata have structural peculiarities akin to Plants. It is perhaps worthy of remark that in Madrepores the top animal is always larger than the side animals, whether in the stem or the branches, as are the buds of a tree, the buds in either case being most vigorous in the most direct line, or in other words, *less vigorous in direct proportion to the number of differentiations from the direct line of the original polyp.*

At the base of the lower Silurian, the Cephalopods, Articulates, and Radiates, disappear together, and save a few Fucoids a little lower, no well ascertained organic remains have been found in examining the rocks downwards through several miles in thickness. It was for this reason that Hugh Miller perceiving that the lines of organization (if I may use the expression) approximate as we trace them downwards in the rocks—backwards in time—speaks of the life of the past as suggesting the idea of an *inverted truncated cone*.

Dana estimates the maximum thickness of the Tertiary rocks at two miles, the Mesozoic at two miles, the Carboniferous at two two-thirds miles, the Devonian at two two-thirds miles, and the Silurian at four miles—thirteen and one-third miles in all. According to Sir Wm. Logan the Cambrian and Laurentian Formations have in Canada a thickness of about seven one-half miles, and it is at the base of these that *Eozoon* (so called) has been found, forming a fitting apex to the cone.

The *Protozoa*, at the base at once of the animal and vegetable Kingdoms, are found, if *Eozoon canadense* and *Eozoon bavaricum* are really of organic origin, as claimed by Dr. Dawson and others, far below, that is, of an earlier period, than any other well recognized organic remains. Most of the existing Protozoans are microscopic. They have been classified as Plant-like, Radiate-like, Mollusk-like, and Articulate-like; a classification which indicate plainly in these—which it can scarcely be doubted are representative of the earlier organisms in the same sense that the Fishes of the present day are representative of the earlier Fishes, that is differentiated asymmetrical modifications of the earlier types—there exists a tendency to the differentiations which are fully developed in the great groups of organic structure next above the *Protozoa*, alike in rank and in the period of their development.

The lowest Plants (*Algæ*) are reproduced by spores (seeds or eggs) which develope powers of motion, swimming about freely by means of vibratile cilia, until, after a time, each attaches itself to a rock or other object, and develops into a plant which has no longer the power of voluntary motion, even in its free extremity. Very similar is the planula of the Polyp, having like locomotive powers until it too fixes itself on some object, retaining, however, the power of motion in its free extremity. Indeed very many forms that were once classed with the *Protozoa*, are now known to be only the mere embryonic forms of the lowest Plants, Radiates, or Articulates, just as the embryonic forms of the higher Radiates have been classed as Polyps, and of the higher Articulates as Worms.

The simpler Protozoans seem to consist of a single cell or of an aggregation of simple cells, without any of that differentiation of tissue which characterizes the higher Orders of animals, and though some of the higher Protozoans *secrete* silica, and others, carbonate of calcium, yet not so as to form a *tissue;* so that these first of Animals exhibit a protoplasmic basis for animal life such as exists in the earliest stage of each individual animal (or community of individuals in the case of such animals as are produced in numbers from the product of a single egg) in the earliest stage of the egg. As we rise in the scale of animal life, or, as we follow the succession of fossils upwards in the formations, or as we follow the progress of differentiation in the egg (in the higher animals) we find in each a corresponding localization of function, and suitable specialization of tissue. It is true that in comparing the first two it is necessary to allow for the greater specialization of the later animals as compared with the earlier of approximately the same grade, while we labor under the serious disadvantage of having so little of the tissue of earlier animals well preserved or in any way directly indicated; and that in comparing the latter with the others it is necessary to allow for the fact that in the egg neither armor for defence nor weapons for attack are needed, nor is there any *functional* organization for reproduction. But allowing for all these the analogy seems perfect.

Dana estimates the comparative duration of the Post Tertiary, Tertiary, Mesozoic, and Palæozoic Periods, as approximately expressed by the numbers 1, 2, 4, 14, respectively. Sir Wm. Logan's estimate of the thickness of the Cambrian and Laurentian rocks of Canada, be taken as the maximum thickness of these, it is probable that they represent a period equal in duration to the Palæozoic Period. So that the various fossiliferous rocks may be estimated to have occupied a Period equal to thirty-five times that of the Post Tertiary, which was probably *not less* than half a million years, so that for the accumulation of the twenty-one miles in the thickness of the various *Zoic* Formations, it will be safe to estimate the minimum duration at fifteen millions of years, though it may have greatly exceeded even this immense Period. But was the Epoch of *Eozoon*, indeed that of the "dawn" of life?

and are we to consider this large and very complex *community* of animals as the primordial type? or should we not look rather for a series of types of increasingly complex, and numerous communities of Protozoans leading up to this? and is it not probable that for no inconsiderable period previous to the existence of *Eozoon Canadensis*, *Protozooa* flourished in great numbers and of great size, the sole living occupants of the Earth?

The obscurities of embryology may be enlightened wonderfully (though I do not remember ever to have seen it remarked) by studying carefully the embryology of that Class of each Sub-kingdom in which individuals of certain Orders change or partially change their habitat, during the free life of each, from water to land, since in those Orders in which the young are brought forth on land, they must have reached a very much more advanced stage before leaving the egg, than in those in which the young become free in the water; and there is thus afforded admirable opportunity of comparing allied forms in the same stage of development, in the one case within the egg, whether intra- or extra-uterine, and in the other while living an active free life in the water; these last occupying, from every point of view, an intermediate position between the first and the Species in the past history of the Earth in which the mature individuals, living of course in the water, represented the same stage of development.

All existing Radiates have these remarkable peculiarities, that they are all sessile at some stage of the life of the individual, and that none of them exhibit any of what we call the five senses, but only simple sensation—the common basis of them all. All Radiates that live in the water, when they first leave the planula are free swimmers, and all the higher Orders of them become free again and continue so during their mature life. Land Plants of the higher Orders, which are radiate in structure, and *competely* sessile in habit, seem almost destitute of sensation, and of the power of motion in their free extremity, and also of the power of digestion, although *Drosera* and some other Genera exhibit all three. The sessile Orders of *Articulata* and *Molluscoida* are remarkable for the fact that as each individual reaches the sessile stage it loses its sight, and the tendency to *Cephalization*, which is a marked characteristic of the Orders of Animals, which preserve the power of free motion, and which progresses in each in time from the earliest period in which we can trace it as a distinct Order, by means of its fossil remains, to the present day. This is manifested by the increasing comparative size of the brain cavity, the lessening and sometimes complete atrophy of the posterior extremity or tail, also by the concentration of the limbs around the anterior extremity and their adaptability to serve its purposes. A shortening of the jaws and increase of the facial angle is also usually characteristic of progress in time among higher Orders of Animals; and in Man, as is well known, it is one of the most obvious distinctions of the higher Races.

In Man the process of cephalization has its fullest realization. The facial angle, that is, the angle made by a line passing from the forehead over the upper jaw, meeting another line passing along the base of the skull, is in the best developed specimens, nearly a right angle. It is true that in the lower Races it is considerably less than this. In the most anthropoid of the Apes it is still less, and it is remarkable that it is less in these when mature than when young, shewing that they in common however, as has been already shewn, with all Vertebrates lower than Man differentiate from homological symmetry as they approach maturity. Next to these come successively other groups of Monkeys of the great Continent, all of which have the same number of teeth as Man, and comparatively narrow noses, hence called *Catarrhines*, while the Monkeys of America, except a peculiar group, have one tooth more, a grinder, on each side above and below, longer jaws and broader noses, hence called *Platyrhines*. In Man only is the attitude entirely erect, the fore limbs being thoroughly adapted for use as prehensile organs,—instruments of wonderful adaptability as ministers to his will. In these respects there is a corresponding gradation among the monkeys, the *Catarrhines* having the thumb opposable to the fingers, and the hand generally rather adapted for use as a hand than a foot, and many species are like man without a caudal appendage, while the *Platyrhines* have not the thumb opposable, but have long prehensile tails. Other groups of Monkeys are still more differentiated, and have been described as Squirrel-like or as

Fox-like—these last being somewhat carnivorous in their habits. The remains of Monkeys have been found in the Eocene in America, and these are found to be of less differentiated types than existing American Monkeys, and have characteristics which ally them to the existing forms of the next lower grades of the *Mammalia*, the *Carnivora* and the *Ungulata* or *Herbivora*, and it is a curious and instructive fact that each of these Orders was at first, without exception, plantigrade, that is, walked on the entire foot as does man and do Monkeys, so that the later digitigrade types were reached in each case by a gradual differentiation. Insectivores, Rodents, and Marsupials present a similar series of types, the lower being plantigrade and the higher, and later, digitigrade. All the *Edentata* and *Monotremata* are plantigrade. All the Mammalian remains of the Eocene are of highly generalized types.

Didelphia consists of Series differentiated so similarly to those of *Monodelphia* as to have the same names applied to them, viz: Marsupial Monkeys, Carnivores, Herbivores, Insectivores, and Rodents. That *Didelphia* had at the time of its greatest expansion marine representatives, corresponding to *Cetacea* and *Sirenia* among the *Monodelphia* is altogether probable. A somewhat similar parallelism exists between the various Orders of Reptiles and Amphibians. Indeed as we trace each great group forwards in time we find a constantly progressive differentiation outward from the general to the particular, or special, from the ominivorous for example, to the more and more completely herbivorous, carnivorous, or insectivorous, and from these to others having still more *specialized* habits as to food, and all the corresponding peculiarities of organization and instinct.

Again there is the tendency outwards as to habitat—to occupy the land, the water, or partly each of these, and that in every climate. Each of these differentiate into flying and non-flying, and some of each of these into climbers, and some into burrowers · in fact each subordinate group as it expands has a tendency to repeat from its own starting point all of these differentiations, and a thousand minor ones; so that each of these differentiations may be more or less fundamental than other co-existing ones. Thus in the *Chieroptera* the adaptability for flight seems more fundamental than that for a particular variety of food, since some exist on almost every variety, while in the Flying Squirrel, and *Galeopithecus* the adaptability for flight seems of a much less fundamental character.

There seems to have been a steady increase in the size of the larger animals of each succeeding grade, corresponding to the increasing induration of tissue; in the water from the Selachian or Shark of the Upper Silurian to the hugh Cetaceans of the Recent Period; and on land from the *Labyrinthodontia* of the Devonian to the Recent Mastodons. The larger animals of each grade seem to have been exterminated by the larger animals of the succeeding higher grade, these having the advantage in the struggle for life in respect of intelligence, activity, strength and ultimately even of bulk. Thus the largest types of each grade, except the highest, have been constantly and successively in every sense undergoing extermination, so that, as we go downwards in grade, we find the existing representatives smaller until we reach the *Protozoa* where they are mostly Microscopic, although when each grade was in maximum it had representatives comparable in size, though not quite equal, to the largest of the succeeding grades. Now as we have seen that directions taken by the different Orders of each Grade, have been approximately parallel or similar, each to each, and as the lower and earlier grade had begun to differentiate soonest it is plain that only its more differentiated types would be well out of reach of this competition of the higher, and that thus the less differentiated types of the lower would be constantly and successively undergoing extermination, and thus only the most differentiated types continue to exist, except when the more synthetic types are preserved, by *isolation* from the access of types of a higher grade, or by a difficulty of access arising from any other cause.

The Great Continent, particularly the northern Grand Division of it, Asia-Europe, has been during the later Tertiary, the Post Tertiary and Recent Epochs the theatre *par excellence* of progress in every organic type, which is represented there. It was not always so, however for North America in the Eocene seems, both in regard to its Plants and Animals, to have reached a stage only reached in Europe and Asia in the Miocene, no doubt by a migration thither of the Plants and Animals of North America, implying, of course, a continuity of the Continents at that time. But while North America has made little progress comparatively in the differentiation of its Plants since the Eocene, it has been far different on the Great Continent, which is consequently now far in advance of North America, and though the differentiation of the higher Animals in North America has been much greater comparatively than of its Plants, yet in this respect also it is in every way inferior and *behind* the Great Continent. South America may be said to represent in a general way the Eocene of North America, and Australia the Cretaceous of North America and the Cretaceous and the Eocene of the Great Continent, while New Zealand with its gigantic birds as the highest type, represents an earlier Mesozoic Epoch, and the Gallapagos Islands with their gigantic Reptiles, probably represent a still earlier Epoch. In each of these cases the comparative cessation of progress referred to, seems to have been the result of isolation from the *then* Great Continents—the chief centre of progress and of differentiation, or in other words, of progress upwards and of progress outwards,—outwards, not only in space but in those adaptations which have given to each great group representatives suited for every possible mode of existence. South America has more recently been again united to North America, but climatic causes have prevented a rapid migration of North American types.

These are a few typical illustrations of a principle illustrated everywhere, since in fact every considerable Island or Archipelago illustrates it, and even on the Continents, great mountain ranges, deserts, &c. serve as barriers to the migrations of land Species, and the Continents themselves to those which inhabit the sea, while to those which inhabit the shallow waters, the ocean depths present a barrier hardly less impassable than to land Species. It must be remembered too that each great group has its own centres, and subordinate groups theirs also, and that these all vary in position with the varying changes of climate, elevation, &c. As a single example of local centres for subordinate groups, the Humming-bird may be given, of which more than a thousand Species inhabit South America, though none are known ever to have existed out of America. Species of the same Family found in localities long isolated from the chief existing centre of differentiation, for that family are usually smaller, less vigorous, and less fully differentiated than the others, resembling the immature forms of the more differentiated Species.

A most interesting and suggestive fact in the distribution of Organic Types is the existence in Regions more or less recently isolated from each other, of representative Families, Sub-families, Genera, Sub-genera, Species, or Sub-species, according apparently to the length of time the isolation has existed, and to the rapidity with which differentiation takes place in the particular Group selected for comparison, and that in lands long isolated from each other the Organic Types are very different, however similar may be the climatic and other conditions. In Europe and North America, which have probably been separate since the Miocene Epoch, many Genera exist having a certain number of Species in the one corresponding to a certain number in the other, *each to each.*

I quote from Prof. Wyville Thompson: "On either side of the Isthmus of Panama the Echinoderm order *Echinidia*, the sea-urchins, are abundant; but the species found on the two sides of the Isthmus are distinct, although they belong almost universally to the same Genera, and in most cases each is represented by Species on each side which resemble one another so closely in habit and appearance as to be at first sight hardly distinguishable, I arrange a few of the most marked of these from the Caribbean and Panamic sides of the Isthmus in parallel Columns.

EASTERN FAUNA.	WESTERN FAUNA.
Cidaris annulata, GRAY.	*Cidaris thouarisii*, VAL.
Diadema antillarum, PHIL.	*Diadema mexicanum*, A. AG.
Echinocidaris punctulata, DESML.	*Echinocidaris Stellata*, AG.
Echinometra michelini, DES.	*Echinometra van brunti*, A. AG.
Echinometra viridis, A. AG.	*Echinometra rupicola*, A. AG.
Lytechinus variegatus, A. AG.	*Lytechinus semituberculatus*, A. AG.

Tripneustes ventricosus, Ag.	*Tripneustes depressus*, A. Ag.
Stolonoclypus ravenilii, A. Ag.	*Stolonoclypus rotundus*, A. Ag.
Mellita testudinata, Kl.	*Mellita longifica*, Mich.
Mellita hexapora, A. Ag.	*Mellita pacifica*, Ver.
Encope michilini, Ag.	*Encope grandis*, Ag.
Encope emarginata, Ag.	*Encope micropora*, Ag.
Rhyncholampas caribbœarum, A. Ag.	*Rhyncholampas pacificus*, A. Ag.
Brissus columbaris, Ag.	*Brissus obesus*, Ver.
Meoma ventrosa, Liitk.	*Meoma grandis*, Gray.
Plagionotus pectoralis, Ag.	*Plagionotus nobilis*, A. Ag.
Agassizia excentricia, A. Ag.	*Agassizia scrobiculata*, Val.
Mœra atropos, Mich.	*Mœra clotho*, Mich.

The Isthmus must have been raised into dry land in Tertiary or Post Tertiary times. It is difficult to doubt that the rising of this natural barrier isolated two portions of a shallow water fauna which have since slightly diverged under slightly different conditions. I quote A. Ag.: "The question naturally arises, have we not in the different Faunæ on both sides of the Isthmus, a standard by which to measure changes which these species have undergone since the raising of the Isthmus of Panama and the isolation of the two Faunæ?"

But it is not only in distinct "areas" that we find "representative" Groups, but they occur successively in the same area, since in successive strata are found representative groups of Species, at wider intervals, of Genera, and at still wider of Families. It is interesting to note in this connection the gradual differentiation of a Sub-kingdom by the steady increase of its Families, Genera, &c., the expansion and differentiation occuring in its central and *characteristic* types, while those types of a more intermediate, synthetic, or connective character, tend to become extinct unless saved by some exceptional circumstance, as isolation, &c.

No Sub-kingdom has left so good a record of itself in the Rocks as the *Mollusca*, and according to Woodward the number of Families for the Formations is approximately as follows: Silurian

20, Devonian 24, Carboniferous 30, Triassic 35, Jurassic 49, Cretaceous 56, Tertiary 62. The Genera for the same Formations in the same Order were 53, 77, 79, 81, 108, 148, and 192 respectively. The decrease of such Families as have become extinct, or seem in process of extinction, is a similarly gradual process, and occurs first in the Genera, least typical of the Family, or most synthetic in type; so that both increase and diminution seem to follow an organic law, which may be illustrated (though of course the analogy is far indeed from being perfect) by the growth of a branch of say a fir tree, and in the case of the Families which have become extinct the gradual withering and successive death of the branchlets, until finally the topmost bud, and with it of course, the branches succumbed to the crowding and pressure of the superior and surrounding branches. Of course the regularity of this process in the family is interrupted by the fact that in isolated areas the older types may be preserved and even extended.

Another difficulty in defining the limits of Species arises from the fact of the intercrossing of Species of the same Genus, and although the product is usually sterile except with either of the original Species, yet the incorporation by this means of an element from one Species into another, seems incompatible with the idea of the two Species having been originally distinct and without any genetic affinity; but the difficulty of entertaining such a supposition becomes still more striking when the product of such intercrossing of Species is fertile *inter se*, as in a case described by the late Prof. Agassiz, and where it is evident that the new Species (shall I say since there is no other possible way of classifying it) might continue to exist, in its entirely distinct form, throughout a Geological Epoch, if brought to a South Pacific Island, where it would be alike free from competition and from admixture with allied Species; indeed in the case referred to below it seems likely to be continued as such in a domestic condition for economic reasons. Agassiz says: "There are, however, two animals entirely distinct as to specific characters—the hare and the rabbit of Europe; (I do not speak of those of the United States, respecting which such observations have not yet been made): these animals have been crossed and offspring has proved to be fertile, not only with the original Species, the hare and the rabbit, but the cross breeds themselves, the individuals derived from the crossing of hare and rabbit have been fertile among themselves. Thus a new breed, which thus far exists only in domesticity, has been produced and is known under the name of leporide in the Paris market, where it is as common now as the hare or rabbit. This new breed differs in the colour of the flesh from both hare and rabbit, the former being dark the latter white, while the leporide has an intermediate condition of meat much esteemed for its flavor and delicacy."

The total number of known distinct existing Species (so called) of Animals and Plants is about half a million. Of these it may be said that the higher the grade to which they belong, and the higher the group within that grade, the shorter lived or less persistent is the Species, and the wider the limits of its variation, so much so that in the case of many it is difficult or *impossible* to decide as to the limits of each. Indeed every attempt to define absolutely what constitutes a Specific distinction, has resulted in failure, and we are left to accept the opinion of Agassiz, that a Species is an ideal "entity," in no way different in kind, but only in degree, from Genera, Family, Order, &c. A hundred illustrations might be given of the difficulty, or rather the impossibility of determining absolutely whether certain groups should be considered as constituting a Genera consisting of a number of Species, or a Species consisting of a number of Varieties. I avail myself of the case of *Rubus*, so well elaborated by Prof. Lawson, and doubtless fresh in the recollection of members. (See Trans. pages 364–6.) "This is particularly the case with regard to the European *Rubi fruticosi*, many of the long recognised species of which are so closely related, that some of our best botanists now rank upwards of twenty forms that are too well marked and too constant to be mere varieties, as so many sub-species under the specific type of *Rubus fruticosus*."

In estimating then the total number of existing Species, the impossibility of defining the limits of each Species is in itself an insuperable barrier to complete success. It must also be remembered that while the land surface of the Earth, and the shallow seas are far from having been completely explored, the deep sea forms are almost unknown, although the researches of the "Challenger" Expedition has shewn that they are abundant, and as the nature of their habitat must effectually prevent the rapid ingress of later, more highly differentiated, and more typical forms, that is, forms typical of a *larger* group, they will be fouud to be more synthetic, and antique in their more general characteristics, such as those pertaining to Order and Family, but at the same time more differentiated iu their more specific characteristics, such as those pertaining to Genera and Species, as was found to be the case with those already discovered. The wonderful development of the organs of vision of the more predatory and active Types and their atrophy in the case of the others, is a striking illustration of the possibilities of differentiation in adaptation to circumstances, though paralleled by the differentiation of the imperfectly sighted types of earlier times into the (usually) better sighted, higher, and more active Types of the present day on the one hand, and into the sightless sessile Types on the other. Any attempt to estimate the numbers of extinct Species must necessarily be very vague from the necessary imperfection of the Geological Record, as well as our as yet imperfect acquaintance with it; but enough is known to make it certain that the extinct Species were many times more numerous than those now existing, so that it is clear that many millions of Species have been created, during a period of millions of years; and this was all accomplished in the most gradual and systematic manner possible, both as to creation and extinction; the apparent exceptions occurring in exceptional circumstances, and themselves conforming to their appropriate laws, and being therefore of that kind which have been said to "prove the rule." It is not therefore surprising that while all, who have any considerable knowledge of the subject, are Evolutionists in the sense of comprehending that creation of the successive types exhibits the gradual evolution or unfolding of certain ideas, a very large majority of the leading Men of Science of the present day believe that the Creator formed the various Species, so called, by the operation of His Laws from a single protoplasmic primordial Type, rather than by a direct, miraculous (in the ordinary sense of that word) creation of as I have said of many millions of Species spread over many millions of years, and governed in the minutest particular by laws involving complications, a few of which I attempted to indicate. It is perhaps worthy of remark that if Species were created by an immediate act instead of by a continuous process, and each put into a particular spot of the land or water, which was to become its home, they must, unless created in considerable numbers, have been miraculously preserved also, inasmuch as otherwise, in many cases, they would be sure to be exterminated almost immediately. Again, a belief in the miraculous creation of each Species almost necessarily leads to a belief in the creation of representatives of it in distinct and often widely distant centres, as was held by the late Prof. Agassiz, and also to this difficulty, that since the various Races of Mankind, exhibit differences equal to and even greater than those which are considered Specific in the lower animals, we are driven to the conclusion, which was reached by Agassiz, viz.: that Man consists of distinct Species and may have had many while he must have had several distinct centres of creation. I quote the words of Agassiz: "Now, then, what do we find among men? Similar differences again. For men have not all the same complexion, nor do they all exhibit the same characteristic features. And here let me urge upon you this fact, for we cannot consider the relations of mankind to monkeys unless we are aware how widely men differ from one another. While they have all the characteristics of humanity, there are yet among them differences about as striking as the differences which distinguish some of these genera of monkeys from one another—as striking unquestionably as the differences of some of the species of monkeys from one another. And I am bound to say that unless we recognize the differences among men, and we recognize the identity of these differences with the differences which exist among animals, we are not true to our subject. And whatever be the origin of these differences, they are of some account, and if it ever is proved that all men have a common origin, then it will be at the same time proved that all monkeys have a common origin, and it will by the same evidence be proved that men and monkeys cannot have a different origin. This is the appalling feature of the subject—that the characteristices which distinguish the different races of men are of the same nature as the characteristics which distinguish the different kinds of monkeys. And it was for that reason that early I maintained that the different races of men must have had an independent origin, because I saw the time coming when the question of the origin of man would be mixed up with the question of the origin of animals, and a community of origin might be affirmed for all. Now, I hold that the idea of the community of origin of man and monkeys and the other quadrupeds is a fallacy, the foundation of which I shall try to explain presently. But if it is error to consider man as derived from monkeys, we must admit that men are not derived from a common stock, because the differences which exist among men are of the same kind and quite as striking as the differences which exist between monkeys, and between the lower animals."

Now, I need not say that a disbelief of the original unity of Man is irreconcileable with Christianity, so that if as Agassiz affirms, a common origin for the Races of Mankind necessarily implies a common origin for the various Species of each Genera of Monkeys, and for each of these Genera and Man, then, from a theological point of view, we would be driven to accept the view which assigns a common origin to Man and the Monkeys, and if to these then to all the Vertebrates, and ultimately to all organic Types.

I have thus endeavored, in intervals snatched from professional study and daily avocations, to sketch in outline this great subject, in undoubting faith that fidelity to truth is the only true fidelity to Religion and to God.

When Man began to arm himself with weapons against the greater Animals within his reach, these had reached their *maximum*, and began to be speedily exterminated before his attacks, for while in the earlier Post Tertiary the greater Continent and North America were the homes of the greatest Megasthenes (or higher Vertebrates) that ever lived, almost equally great Edentates flourished in South America, and similarly vast Marsupials in Australia, while Cetaceans probably the largest, without exception, of animals that ever lived, flourished in the Polar Seas. Of all these most of the largest have perished already, while as Man improves his arms and adds to his intelligence, the greater animals which he refuses to take under his protection are rapidly disappearing before him.

The process of extinction, therefore, has been proceeding during the Recent or Human Epoch with a constantly accelerating and unparalleled rapidity. But while Man is rapidly exterminating *most* Species which are within his reach, and which he does not choose to protect, the number which he takes under his protection is continually increasing, and it so happens (though of course there is no chance in the matter) that the Species, which for economic purposes he takes under his protection, are precisely those which are the representative types of the Families or great Groups to which they belong,—the topmost buds of the greater branches of the tree of life. They are thus the natural centres of differentiation, possessing at once the greatest vital power and the greatest possibilities of variation, hence also of cultivation and of naturalization of every part of the Earth,—processes which I need not say are being accelerated yearly, almost daily, with the increasing facilities for locomotion which are so characteristic of the current century,—processes which have already afforded results the most invaluable to mankind, and promise incalculable advantages in the future.

But it is in Man, himself, the representative of the entire Group of organic types,—the topmost "upright" stem of the Tree of Life, that all the possibilities of differentiation and of culture culminate, and I do not therefore share the gloomy anticipation of Prof. Dawson, that there will "ensue a period of decadence until it (the human race) becomes extinct," but believe that in Man as in the lower animals, while the inferior and more synthetic types will be successively exterminated, the higher and more differentiated types will be continually expanding, and that the "meek shall inherit the Earth."

ART. XIII.—CHEMICAL RELATIONS OF HEAT. WITH EXPERIMENTS. BY PROFESSOR LAWSON, PH. D., L. L. D., *Dalhousie College.*

HE explained the nature of heat as a form of force, co-relative with light, mechanical energy, electricity, magnetism, and chemical affinity, showing the one to be convertible into the other. These forces influence matter; upon the varying degrees of heat depends the condition of matter, whether it exists as a solid, a liquid, or a gas. Water is solid at low temperatures, when we give it more heat, raising the temperature to 32°, it becomes a mobile liquid; if the temperature be raised to 212°, the water has its condition changed to that of an invisible gas, which we commonly call steam. As soon as the excess of heat above 212° is removed, the gas (or steam) passes back into the liquid state, and then if further reduced (below 32°) into a solid, which is the present condition of all surface water in this part of the world, except in the deep sea or in deep lakes, &c., where it has not been cooled down to that temperature. In still waters, however, a foot or two of the surface forms our ice-bridges and skating ponds).

Illustrations were given to show that when a liquid passes into a gaseous state it absorbs heat, which it necessarily takes from surrounding bodies, and makes them cold. Ammonia, ether, alcohol, vinegar, all readily volatilise, pass into the gaseous state, and the absorption of heat, to enable them to do so, necessarily produces a sensation of cold on the skin. The most remarkable body shown was sulphur dioxide, which, when poured on the back of the hand, evaporates instantaneously, produces intense cold, and freezes the flesh if used in too great quantity. The freezing of the hand in this way presents all the uncomfortable and dangerous symptoms of natural freezing at an excessively low temperature in an extreme climate. The evaporation of sulphur dioxide *in a current of air* produces a still lower temperature, freezing mercury, which does not solidify till the temperature goes down to 39° below zero. All these temperatures are of the Fahrenheit scale, the only one known in Nova Scotia except in scientific laboratories, where the Centigrade system is coming into use, and must in time prevail.

Professor Lawson entered into a full description of sulphur dioxide, which is always produced as a gas when sulphur is burnt in the air or oxygen; it is also produced in the burning of coals containing pyrites or sulphur compounds; and the wilting of house plants, and probably the occurrence of coughs and colds in winter, are to some extent due to its occurrence in sitting rooms. Its old name is sulphurous acid gas. It is known also by the names of sulphurous oxide, sulphurous anhydride, &c., but every one is familiar with it by smell, as that of the "smell" of burning sulphur. The gas extinguishes flame, and the burning of sulphur is a common remedy for extinguishing a fire in a chimney. However, several metals will burn in the gas, decomposing it—as, for example, potassium, which forms polysulphide, sulphate, and thiosulphate; when simply heated to about 2200°, it is decomposed into free S and O. It has decided bleaching properties, and is used for wool, silk, sponge, isinglass, and other animal substances that would be injured by chlorine; also for straw hats and willow baskets. A solution of the gas will remove fruit stains and wine stains from linen. It acts as a disinfectant, an antiseptic, and has been used in preserving meat; it is also an arrester of fermentation, on account of which wine and beer casks are sulphured, and sulphites are used in breweries and sugar factories. It preserves vellum and catgut. One of its most remarkable effects is that produced by its inhalation; it is not only irritating, like hydrochloric acid gas, and suffocating, like chlorine, but, when inhaled in a concentrated form, it *immediately* produces catarrh and sore throat, with all the ordinary symptoms of the natural malady, from which both the Professor and his assistants (Messrs. Lindsay and Stewart, medical students) had suffered more or less during successive investigations.

The gas is $2\frac{1}{2}$ times the weight of atmospheric air (sp. gr., 2·25). It is very soluble in water, which absorbs about 40 times its bulk of the gas at ordinary temperatures; the solution, when exposed to air in a bottle, changes slowly to solution of H_2SO_4. At low temperatures a crystallized hydrate of sulphurous acid is obtained. In preparing the gas for condensation, the tubes must be kept dry, otherwise this hydrate forms in them and stops them up. At zero F, which may be readily attained by a freezing mixture of old frozen snow and salt (newly-fallen snow does not answer well,) the sulphur dioxide gas is easily condensed to a liquid, which is heavier than water, sp. gr.=2·38). The boiling temperature of this liquid, however, is 14°, and when in sealed tubes (if the temperature be raised to 60°, that of ordinary air) it exerts a pressure of 2½ atmospheres. At between 105° and 110° below zero the liquid freezes into solid crystals, which are heavier than the liquid. To succeed perfectly in showing the boiling of the liquid dioxide by heat of the hand, it is necessary to have a twist of cotton, enveloping freezing mixture, around the top of the tube, to provide for rapid condensation; or the tube may be fitted with an encircling short piece of much wider tube at the top to contain the freezing mixture.

The next experiment was a very remarkable one. A platinum crucible was made red-hot, the dioxide was thrown into it, and immediately passed into the spheroidal state, water was added, and the red-hot crucible became filled with ice—the whole having cooled down in half a minute from red-hot to a temperature far below freezing, and under favorable circumstances it would reach 40° below zero, so that even mercury could be frozen.

Professor Lawson, in referring to the great opportunities which we have in this climate of studying the effects of heat, exhibited a large bottle containing several pounds of glacial sulphuric acid, that had separated and crystallized spontaneously from a solution of ferrous sulphate in oil of vitriol during the recent severe weather. The small portion of solution left in the bottle had a sp. gr. of 1.612.

APPENDIX.

CONVERSAZIONE.

A Conversazione was held in the New Provincial Building, on Thursday evening, February 12, 1874.

The Rev. Dr. Warren exhibited a beautiful series of dissolving views with Oxycalcium Lantern.

The Members of the Institute and their friends, having then taken their places in the Long Room of H. M. Customs, which had been kindly given up for the occasion by (the late) E. M. McDonald, Esq., Collector.

His Honor the Lieutenant Governor the Patron of the Institute, who occupied the Chair, made an appropriate and admirable address upon the work of the Institute, and urged strongly its claims upon the support and encouragement of the people of Nova Scotia. He showed the great importance of the work and gave prominence to the fact, that the workers gave their time and energies without remuneration, and rather with pecuniary sacrifice. He also showed that by their Publications they were disseminating at home and abroad a great amount of valuable information upon the resources of the Province.

The Hon. Chairman then called upon Dr. Honeyman, who gave a short lecture " On the Deep Sea." He gave an account of the progress of enquiry into the character of the depths and their inhabitants, as exhibited especially by the expeditions of H. M. S. S. *Porcupine*, *Lightning* and *Challenger*.—The observations made were illustrated by specimens from the Museum Collection, particularly those kindly presented by Prof. Wyville Thomson when the *Challenger* visited Halifax.

Dr. Gilpin being called upon read an interesting and eloquent lecture " On a Fossil Whale," which had been excavated in the previous Summer in the Jacquet River section of the Intercolonial Railway. The descriptive part of the lecture will be found in the Transactions.

The Rev. Dr. Warren succeeded. The Reverend gentleman remarked that that evening they had been invited to look at God's wonders in the deep sea; and said, he would now direct the attention of his audience to another ocean in which *we* live, move, and have *our* being, claiming moreover for it an importance, magnitude, and utility second to none in the universe. He then pointed out in graphic language its numerous uses in the economy of nature; aud further showed how the health and happiness of animate creation are necessary involved in the purity of its life-giving, life-sustaining, or life-destroying fluid.

Having spoken of some of the peculiar *properties* appertaining to this subtle gaseous matter, he proceeded to illustrate several great scientific laws by a series of striking and instructive experiments, all of which depended more or less upon the Elasticity of Air.

The subject as treated, clearly proved that Science and Recreation are not incompatible.

Dr. LAWSON then gave a short lecture "On the Chemical relations of Heat. An account of this lecture by the Author will be found elsewhere.

This part of the proceedings was finished by an admirable *resume* of the address given by the Chairman.

After this there was a promenade in the Museum, and refreshments in the Office of the Inland Revenue, which had also been kindly vacated for the occasion by the Inspector and Collector Messrs. PATTERSON and TUPPER. Here Mrs. WARREN and Miss CLARKE provided for and ministered to the wants of the Assembly. Mr. S. A. PORTER, Organist of St. Paul's, and a select band, kindly furnished the music for the Conversazione—performing select pieces at intervals during the evening.

The Institute is under great obligations to Dr. WARREN, in undertaking the management, for the trouble taken, and the zeal displayed, which consequently resulted in a very excellent and delightful Conversazione.

H.

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NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE, HALIFAX, NOVA SCOTIA.

PATRON—His Honor The LIEUTENANT GOVERNOR.

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The Anniversary Meeting of the Institute is held on the *second Wednesday* in October of every year.

The Monthly Ordinary Meetings of the Institute, when Papers are read, are held on the second Monday evening in every month, commencing in November and ending in May.