Prof. Dana
Ed. of Silliman's Journal
of Science & Art

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

OF

HALIFAX, NOVA SCOTIA.

VOL. IV. 1876–77. PART. III.

CONTENTS.

HALIFAX, NOVA SCOTIA—WILLIAM GOSSIP, 103 GRANVILLE ST.
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1877.

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ANNIVERSARY ADDRESS, 1876.

By Wm. Gossip, Vice-President.

It is a duty imposed by the rules of the Institute, that at every recurring Anniversary Meeting the President shall deliver an Address, which shall embody some account of its present circumstances and future prospects. I did not expect that our worthy President, Dr. Bernard Gilpin, would be in Halifax upon this occasion, and as the next in office, I prepared to comply with the requirements of the rule that imposes the duty. I am very glad that he has arrived in time to preside at this Annual Meeting, although I am not so well pleased that he persists in devolving upon me a duty of his office which he is so much better able to perform.

There may have been very little to communicate that was new or of much interest, at preceding anniversaries; and so far as I know there is little of importance to communicate now. But occasional non-observance of rules begets a general looseness of practice, which at length must have injurious effect upon the working of any institution. A short address, therefore, at our annual meetings, will not be at all inappropriate, and may help to create an interest in our proceedings; and this rule, which has not hitherto been carefully observed, being a good one, we should probably suffer, sooner or later if we forgot it entirely, from the absence of that systematic operation, wisely marked out for us by those who framed it, who took great pains, and followed the best examples at their command, to make the Institute thoroughly efficient.

I do not intend to occupy your time with scientific topics. Our concern, this evening, is more with matters connected with the management of the Institute. Even on these my knowledge is not so intimate or complete as it ought to be, and what I have to offer will be more suggestive than dogmatic.

It happens unfortunately, that our able Secretary, upon whom the chief burden of the work of the Institute rests, is at the Philadelphia Centennial Exhibition, in charge of the Nova Scotian contingent of that immense display of the ingenuity and labour of the nations of the world; and therefore some information must necessarily be omitted which otherwise would have been placed before you. It remains, however, in good hands. Further, with the opportunities he has enjoyed of being acquainted with the Exhibition, we may expect at some one of our ordinary meetings after his return, an animated description of much that was important and interesting there,—so that those of us who have not visited Philadelphia on this occasion, may have less reason to regret that we have remained at home.

To members present, unacquainted with the rules which govern the proceedings of the Institute, I may observe that our Annual or Anniversary Meeting takes place on the second Wednesday of October in every year. The outstanding accounts of the previous year are then submitted, examined and passed; the Treasurer's statement laid before you, and audited; also the state of our funds and their sufficiency to meet expenses incurred, and that have to be incurred. The officers for the ensuing year are then ballotted for and elected; new members proposed, and so far as possible the papers to be read at the ordinary monthly meetings, commencing on the second Monday of November, and ending May of the following year, provided for. All this business has been carefully attended to at previous anniversaries, by the Council of the Institute, and you will find that body ready to give any explanation that may be asked of them with reference to these or other matters that have come under their supervision. They meet every fortnight during the Winter session.

I am glad to say that our onward progress, if not all that could be desired, has been steady and assured. We are continually receiving accessions to the roll of membership. As to our finances, we have hitherto, and with the help of the Legislature, which has annually for some years past, voted us a small sum of money to enable us to publish our Transactions, kept out of debt. That assistance, which is amply repaid by the information we are thus enabled to send abroad of the natural resources of Nova Scotia, has become almost indispensable, inasmuch as it never has been very easy, although our books show the large number of some seventy members, to collect the full amount of subscriptions Means will, however, be adopted whereby it may be hoped such liabilities will be made more available for the support of the Institute. We may safely assert then, that our finances, if not flourishing, are in a satisfactory state, and that in so far we can go on our way rejoicing.

We are the more encouraged in our work, which is entirely disinterested, by the estimation in which the Institute is held by sister societies abroad. With some of the most celebrated among them we exchange our "Transactions," in which they evidently take a special interest. From Australia, from Canada, from most of the Scientific Associations of the United States; from Denmark, from Italy, from Germany, from Russia, from England and Scotland—we receive their publications. We also, occasionally, find in scientific periodicals, favorable notice of the work of our Institute. I may mention that we have published three bound volumes of our Transactions, covering twelve years of our existence, and can refer to them with some degree of pride, as the best works on the various sciences of Geology, Zoölogy, Botany, and Meteorology, &c., so far as Nova Scotia is concerned, that have ever issued from the Provincial press. And the fourth volume (making sixteen years work) goes bravely on, and will appear in due course of time.

That the small income of the Institute cramps its usefulness and prevents its expansion, must, I think, be evident to all. The insufficiency is felt in various ways. We want a more convenient place for our winter ordinary meetings, which cannot be had without trenching upon funds required for other necessary purposes. For our present accommodation we have been indebted principally to the Local Government, and next, to the kindness of Dr. HONEYMAN, our Honorary Secretary. Much as we desire to value the privileges so enjoyed, it would still be better, I think, if we had a convenient room we could call our own, in a central part of the city; and I venture the hope that some practical suggestion, that carried out may accomplish the result, will be made. We shall not affect to despise any assistance that may be afforded us, pecuniary or otherwise, in this behalf. In the meantime, we owe the Provincial Government thanks for its appreciation of the objects of the Institute, manifested in this and other modes in its behalf; and to Dr. HONEYMAN, for doing all in his power to make the Museum a convenient place for our meetings.

Our want of means also prevents us from adding to the Institute a library of publications on Natural Science, which would not only be a source of profitable amusement and intelligence to those of our members who are interested in such pursuits, but a great assistance to such of us as may feel inclined to take the trouble of composing papers on subjects which come within our knowledge, on which we may have arrived at some degree of proficiency. We already possess some valuable books of this description, but the want of many more is being felt continually.

We would also like to be able to invite to Halifax, occasionally, men celebrated in various walks of science, who might communicate by papers read before our Institute, or otherwise, some of the knowledge they themselves possessed. Such incentives to progress could not fail to be of service to the Institute, and valuable to the whole community.

It would likewise be pleasing to many of us if more of our members would furnish papers for the Ordinary Meetings. Accident ofttimes, and careful observation frequently, elicit facts and discoveries, which help to settle doubtful points of science, and all such would be very interesting at those meetings. At present, valuable as our monthly papers may be, and we believe are, we depend nearly altogether upon a stereotyped list of authors. We beg, however, to state, lest there may be some misapprehension on this head, that it is not because the papers read have been superior to others at our disposal, but because none other are submitted, that the same names are so often announced. We do not know of more than one instance where a paper written with fair grammatical accuracy, and treating of any branch of Natural Science, has been withheld. It might have been as well, perhaps, on occasion, that all had not been printed; but whenever there has been a question of orthodoxy, or a doubt of usefulness or propriety, they have not been published without a reason given for their becoming a part of our Transactions. I mention this, because a periodical of this city is said to have contained some depreciatory observations on a paper of Mr. Dewar's, so published. Not having seen the critique, I am unable to judge whether, as respects the article in question, it was just or unjust; but the writer, whoever he may be, if disposed to find a reason for printing that paper, could not have failed to find it in the book of Transactions itself; and we hope we may be allowed to be the best judges of the most judicious mode of conducting our own affairs.

It would have given me much pleasure to state that we had observed the prescribed number of Field Days during the past summer. We have again fallen short of our rules in this particular. At the formation of the Institute it was supposed that those excursions would be generally taken advantage of, as pleasing and popular features of our proceedings. In no one year, however, since that time, has there been found much enthusiasm in their behalf, or willingness to engage in them. This may be attributed to the fact that each member of the Institute considers his public or private business of paramount interest, and the pursuit of science in this way quite a secondary object. I often think it a pity that it should be so at all times, and that we lose a large amount of knowledge and of profitable recreation by not attending to those pleasant meetings. I am glad however to record, that we have had one field excursion during the past summer, attended by thirteen members. The country explored lies between Wellington Station and the Grand Lake. Some interesting facts were pointed out by Rev. Dr. Honeyman, corroborative of the sequence of geological formations, and of a long continued ice drift of the glacial period, from the Cobequids. All present appeared highly delighted with the excursion; and on arriving at Oakfield, the estate of Colonel Laurie, we were handsomely entertained by the hospitable Colonel and his estimable lady.

That the Nova Scotian Institute, cramped as are its means and resources, has done and is doing a good work in and for the Province, it is impossible to deny. It is making us better known at home and abroad, creating an interest in our natural resources, active and inert, that is assisting their development, and paving the way for the introduction of capital and enterprise. Let us not, therefore, remit our exertions. Every member of the Institute can help the cause, — I may be pardoned in saying, can do more for it than he has hitherto done. There is no royal road to the acquirement of science. It demands to some extent self-sacrifice on the part of all who may profess a desire to encourage it. Dry as may be some of its details, they lie at the foundation of the wealth of nations, and its active votaries are all the better for the stimulus of judicious approval. There ought, gentlemen, to be a much larger attendance at our monthly Ordinary Meetings. Those who take the trouble to prepare papers for our instruction and amusement, and who find some eight or en out of seventy members assembled to listen to them, cannot feel much inclination to repeat the task, or recommend it to others. Some of those papers have settled questions which concern our own Province in Geology and Zoölogy, in Botany and Meteorology, for all time to come. But there is a large amount of talent in this community, and amongst our own members, which has never yet engaged itself in our behalf, and from which good may be yet expected. We await with patience its development under favorable auspices. Meanwhile, with Rev. Dr. Honeyman in our Geological section, Dr. Bernard Gilpin, J. M. Jones and others in the Zoological; Professor Dr. Lawson, Rev. Mr. Ball and Dr. Somers in the Botanical; Frederic Allison, the Dominion Meteorologist, and others in cognate departments of Natural Science, we maintain and uphold our standing very well with kindred Institutions elsewhere; and our publications, to which I have before alluded, show that these gentlemen have not spared themselves in the service of the Institute, for the promotion of the laudable objects in which it is engaged.

I feel assured that we are all glad to know that Dalhousie College has come to the aid of Physical Science, and that there is every prospect of its becoming a permanent feature in her course of instruction. A shining light of Nova Scotia, Dr. McGregor, one of her Alumni, comparatively young in years, but who has already made his mark in the Universities of the world, is to be the first occupant of the new Chair. I can not affirm that the example of our own Institute has had any weight with Dalhousie in the determination—most probably none at all,—but of this I am sure, that the University is entering upon a course of study which, so far as the training of our youth is concerned, is second to none in importance in her whole curriculum, and which, if zealously persisted in, will place her higher than ever in the estimation of all orders of the community. We may, I hope, expect from the liberal character of the learned Professor, and also from the Alumni of his department, much assistance in our own work.* Our members cannot all be students of Dalhousie, but she may do herself honour beyond College bounds by lending her aid to the public enlightenment. Nay, this is part of the work to which she is appointed, and in its accomplishment she will best fulfil her destiny.

In conclusion of this general but imperfect summary of the doings of the Institute, I may as well say that I have been far from intending to deal harshly with shortcomings. These may be easily avoided or amended, and there is a bright side to the prospect, to which I would shortly advert. I remember that at our first Ordinary Meeting, fifteen years since, the present Provincial Secretary, still a member of the Institute, delivered the Inaugural Address. Then, the Marquis of Normanby, at that time our Lieutenant Governor, attended our meetings, and gave us in his plain, unvarnished but forcible style, a word of encouragement. After him Sir Richard McDonnell, another Lieutenant Governor, would have done us more honour than our conduct towards him deserved at his hands. I am compelled, in mentioning his name, to make this acknowledgment. Our Governors have invariably been our patrons, and have been pleased to preside whenever we have held a conversazione. We should like them to go a little farther than this, as some of their predecessors did not think it

* Which has since been rendered in an excellent Paper on Electricity delivered at one of our Ordinary meetings.

unwise to do,—but this also is quite capable of amendment. Chief Justice Sir William Young, a consistent member of our Institute, has frequently attended our meetings. The Bishop of Nova Scotia is also one of our members. A goodly list from among the clergy and the bar follow in their wake. We may hope soon to be an Incorporate Society, a status which we believe the Legislature will concede to us whenever we think proper to make the claim.

Upon the whole, then, there appears to be nothing that we can reasonably desire, that is not attainable by active and judicious management; and I express my perfect conviction that the Officers and Council of the Institute, whom you may elect to-night, will do their utmost to promote its efficiency in every way that may be desirable, that approves itself to their judgment.

Trusting that you will pardon me for occupying so much time with matters which principally concern ourselves, with which we are all more or less familiar, but which are not without a certain degree of significance to the community at large; and that you will excuse my rather lengthy performance on the ground of its infrequency,—we may now, with the sanction of the President, proceed with the election of officers for the ensuing year.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART III.

Provincial Museum, Oct. 11, 1876.

ANNIVERSAY MEETING.

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

Inter alia.

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

President—J. B. GILPIN, M. D., &c.
Vice-Presidents—WILLIAM GOSSIP, F. ALLISON, M. A.
Treasurer—W. C. SILVER.
Joint Secretaries—Rev. D. HONEYMAN, D. C. L., &c.; J. T. MELLISH, M. A.
Council—A. P. REID, M. D., G. LAWSON, LL. D., &c.; Sheriff BELL, J. M. DEWOLFE, M.D., &c., J. SOMMERS, M.D., L. G. POWER, ROBERT MORROW, AUGUSTUS ALLISON.

ORDINARY MEETING, November 13, 1876.

Dr. J. B. GILPIN, *President, in the Chair.*

The SECRETARY announced that the Council had elected Mr. GEOFFREY MORROW a member of the Institute.

The PRESIDENT exhibited a sketch of a piece of carved stone or rock which he had found near Digby. He thought that the characters were Aztec rather than Runic. Dr. Gilpin also exhibited a beautiful Indian pipe.

J. SOMMERS, M. D., then read a paper on the "*Compositæ of Nova Scotia,*" and exhibited several preserved specimens of Asters, which he very minutely described. (*See Transactions.*)

ORDINARY MEETING, Dec. 11, 1876.

The PRESIDENT *in the Chair.*

The SECRETARY stated that Dr. DEWOLFE, of London, Eng., had been elected a corresponding member of the Institute.

The President, Dr. GILPIN, made some highly interesting and instructive observations on specimens laid on the table :—

1. On a specimen of the Head of a dead Pelican, found lying on the shore at Upper Prospect.

2. On a Stone Axe found in Dartmouth, and presented to the Museum by Mr. DONALD ROSS, of Dartmouth.

Mr. A. DEWAR then read a paper entitled: "*A New Theory of the Descent of Man*," after which a discussion took place in which the PRESIDENT, Dr. REID, Dr. SOMMERS, Honble. L. G. POWER, and Dr. J. G. MCGREGOR, took part.

ORDINARY MEETING, January 13, 1877.

The PRESIDENT *in the Chair.*

It was announced by Mr. MELLISH that Dr. J. G. MCGREGOR and Mr. J. P. HAGARTY had been duly elected members of the Institute.

The Rev. Dr. HONEYMAN read a printed communication from PRINCIPAL DAWSON, giving an account of a recent discovery of Fossil Batrachians in the Coal Formation of the South Joggins. This discovery added new Reptiles to the list already recorded as found at the Joggins by the author, and also threw new light on the whole subject. The communication is to be found in *Silliman's Journal.*

DR. A. P. REID then read a paper "On the Rates of Mortality in Ancient and Modern Times." The observations in the paper were general in character, and distinctly exhibited facts in favour of the view that the death rates have been much lower in modern than in ancient times. (*See Transactions.*)

ORDINARY MEETING, Feb. 12, 1877.

The PRESIDENT *in the Chair.*

The SECRETARY announced that he had received the Transactions of the Academy of Sciences of Davenport, Iowa, and also the first number of a similar publication from the National Historical Society of Brazil.

The Rev. Dr. HONEYMAN read a paper "On Nova Scotian Geology at the Centennial." After reading his paper, Dr. H. made some observations on the "*Eozoon Canadense*," (Dawson). Its nature was illustrated by beautiful microscopic sections prepared with great care by T. Weston, Esq., of the Geological Survey of Canada, and by *nummulites* partially and entirely filled with *glauconite.* Its forameniferal relations were illustrated by foramenifera from dredgings from H. M. S. *Challenger.* Dr. H. stated that there was difference of opinion in regard to the true nature of the *Eozoon*,—some regarding it as an organic and others as a mineral structure, while yet others were undecided. (*See Transactions.*)

ORDINARY MEETING, March 12, 1877.

The PRESIDENT *in the Chair.*

W. GOSSIP, Esq., Vice President, having taken the Chair, Dr. GILPIN read an interesting paper "On the Indians of Nova Scotia." The subject was illustrated by sketches and pictures by different writers. (*See Transactions.*)

ORDINARY MEETING, April 9, 1877.

The PRESIDENT *in the Chair.*

ROBERT MORROW, Esq., read a highly instructive paper "On the Anatomy of the Cariboo." The subject was illustrated by a number of specimens of the limbs, skin, head and other parts of the animal. (*See Transactions.*)

A paper was then read "On a new method of Measuring the Resistance of Electrolytes," by J. G. MCGREGOR, M. A., D. Sc., (Lond.) In this paper a new method was described combining the advantages of both Kohlrausch's method and of that described by Mr. EWING and the author in the Transactions of the Royal Society of Edinburgh (vol. xxvii.) The author had submitted his method to various tests, and had found that "polarization" had been eliminated, at least in so far that its effects could not be observed even with the most delicate instruments. The measurement of the resistance of electrolytes is thus rendered as easy as that of metallic conductors.

At the close of the lecture, Mr. MELLISH proposed some questions respecting lightning and the conducting power of the atmosphere, which Dr. McGregor satisfactorily answered.

ORDINARY MEETING, May 14th, 1877.

The PRESIDENT *in the Chair.*

It was announced that THOMAS WESTON, Esq., of the Geological Survey of Canada, had been elected a corresponding member; also, that the Rev. JOHN BURWASH, of Sackville, N. B., had been elected an associate member.

PROFESSOR LAWSON read a paper by Professor How, replete with scientific information, "On the Botany of Nova Scotia." (*See Transactions.*)

FREDERICK ALLISON, Esq., M. A., Chief Meteorological Agent, read his Report for the year 1876. The results of Mr. ALLISON's services in the work of recording facts and determining laws respecting the meteorology of the Province are certainly of a most useful and valuable character. (*See Transactions.*)

J. T. MELLISH, M. A., communicated a paper by Professor Burwash, "On the Albertite Mines at Belliveau, New Brunswick." (*See Transactions.*)

LIST OF MEMBERS.

Date of Admission.			
1873.	Jan.	11.	Akin, T. B., D. C. L., Halifax.
69.	Feb.	15.	Allison, Augustus, Halifax.
69.	Feb.	15.	Allison, Frederick, *Chief Meteorological Agent*, Halifax.
64.	April	8.	Bell. Joseph, High Sheriff, Halifax.
63.	Jan.	8.	Bell, Thomas, F. G. S., Newcastle-on-Tyne, England.
73.	Jan.	11.	Binney, Edward, Halifax.
74.	April	13.	Black, G. P. Halifax.
64.	Nov.	7.	Brown, C. E., Halifax.
74.	Feb.	10.	Brunton, Robert, Halifax.
67.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
74.	Apr.	13.	Colford, Henry, Halifax.
71.	Apr.	4.	Compton, William, Halifax.
72.	Apr.	12.	Costley, John, Halifax.
63.	May	13.	Cramp, Rev. Dr., Wolfville.
74.	Apr.	13.	Creighton, Aylwin, Halifax.
70.	Mar.	30.	Day, Forshaw, Artist, Halifax.
75.	Jan.	11.	Dewar, Andrew, Halifax.
63.	Oct.	26.	DeWolf, James R., M. D., Edin., L. R. C. S. E., *Vice-President*, Dartmouth.
63.	Dec.	7.	Downs, Andrew, *Corr. Memb. Z. S.*, London, Halifax.
75.	Dec.	13.	Edwards, Lieut. Hope, 60th Rifles, Halifax.
71.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
75.	Dec.	13.	Fairbanks, Lewis P., Dartmouth.
74.	Apr.	13.	Forbes, John, Manager of Starr Works, Dartmouth.
72.	Feb.	12.	Foster, James, Barrister-at-Law, Dartmouth.
76.	Mar.	13.	Fraser, J. F., Richmond, Halifax.
74.	Apr.	13.	Frith, G. R., Halifax.
63.	Jan.	5.	Gilpin, J. Bernard, M. D , M. R. C. S., *President*, Halifax.
63.	Feb.	2.	Gossip, William, *Vice-President*, Granville Street, Halifax.
76.	July	20.	Greville, Hon, Mr., 60th Rifles, Halifax.
63.	Jan.	25.	Haliburton, R. G., F. S. A., Halifax.
76.	July	20.	Hampton, William, Halifax.
63.	June	27.	Hill, Hon. P. C., D. C. L., Provincial Secretary, Halifax.
66.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., *&c.*, *Secretary, Prov. Museum*, Halifax.
68.	Nov.	2.	Hudson, James, M. E., *Superintendent of Albion Mines*, Pictou.
72.	Feb.	5.	Hunt, Rev. A. S., A. M., *Superintendent of Education*, Halifax.
74.	Dec.	10.	Jack, Peter, Halifax.

1873. Jan. 11. James, Alexander, Mr. Justice, Dartmouth.
63. Jan. 5. Jones, J. M., F. L. S., Halifax.
66. Feb. 1. Kelly, John, *Dep. Chief Commissioner of Mines*, Halifax.
64. Mar. 7. Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, Dalhousie College, Halifax.
75. Jan. 1. Mellish, John T., M. A , SECRETARY, Halifax.
72. Feb. 5. McKay, Alexander, *Principal of Schools*, Dartmouth.
75. Feb. 12. McKay, Adam, Engineer, Dartmouth.
66. Feb. 8. Morrow, James B., Halifax.
72. Feb. 13. Morrow, Robert, Halifax.
73. Mar. 10. Moseley, E., Dartmouth.
70. Jan. 10. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., *Lord Bishop of*
74. Mar. 9. Pitts, D. H., Halifax.
63. Jan. 16. Poole, Henry M. E., Derbyshire, Eng.
72. Nov. 11. Poole, H S., F. G. S., *Inspector of Mines*, Halifax.
70. Jan. 20. Power, L. G., Senator, Halifax.
66. July 28. Reeks, Henry, Manor Hall, Truxton, Hamp., England.
71. Nov. 29. Reid, A. P., M. D., Halifax.
74. Nov. 9. Robertson, Thomas, Halifax.
66. Jan. 8. Rutherford, John, M. E., Halifax.
64. Mar. 7. Silver, W. C., TREASURER, Halifax.
68. Nov. 25. Sinclair, John A., Halifax.
76. Mar. 13. Skimmings, Robert, Halifax.
75. Jan. 11. Sommers, J., M. D., Halifax.
74. Apr. 11. Stirling, W. Sawyers, Halifax.
73. Jan. 13. Waddell, W. Henry, High School, Halifax.
74. Nov. 9. Walker, John McAra, Saint John and Halifax.
66. Mar. 18. Young, Sir William, Knt., *Chief Justice of Nova Scotia, Halifax.*
77. Jan. 13. McGregor, J. G., M. A., D. Sc., Bristol, Eng.
77. Jan. 13. Haggarty, J. P., Halifax.
77. Jan. 13. Morrow, G., Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 6. Ambrose, Rev. John, A. M., Digby.
66. Mar. 13. Calkin, J. B., M. A., *Principal of Normal School*, Truro.
73. Apr. 11. Gilpin, Edwin, M. E,, F G. S., Springville, Pictou.
75. Nov. 9. Kennedy, Professor, Acadia College, Wolfville.
76. Mar. 13. Kerr, James J., Amherst.
75. Jan. 11. McKay, A. H., A. M., *Principal of Academy*, Pictou.
75. Nov. 9. McKinnon, Rev. John, Hopewell, Pictou.
75. Dec. 13. McKenzie, William, Surveyor, Moncton, N. B.
65. Dec. 28. Morton, Rev. John, Trinidad.
72. Mar. 27. Moseley, E. T., M. P. P., Cape Breton.
76. Mar. 13. Patterson, Rev. George, D. D., Greenhill, Pictou.
May 14. Burwash, Rev. J., Sackville, N. B.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. E., Springhill.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
66.	Sep.	29.	Chevalier, Edgecumbe, H. M. Naval Yard, Pembroke, England.
76.	Dec.	11.	Dr. DeWolf, Tintern, England.
77.	May	14.	Thomas Weston, Geol. Survey of Canada.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I.—Notes on Nova Scotia Compositæ,—Asters. By J. Sommers, M.D., *Prof. Physiology, Halifax Medical College.*

(*Read before the Institute, November* 13, 1876.)

The genus Aster being a natural division of the order Compositæ, attracts our attention, because of the beauty and variety of its forms. It is interesting also, because it supplies the botanist with the latest floral treasures which our short season affords for his study and subsequent reflection ; with the golden-rods they light up our autumnal landscape, like a lingering ray of our departed summer.

The generic characteristics of this group are exceedingly well marked, none others in the whole botanical classification being so separated from their congeners by natural distinctions.

Their specific diagnosis is, however, exceedingly difficult, as is acknowledged by the diversity of nomenclature and doubtful separations of species, the elevations of varieties into species, and of individuals into varieties, by different authorities, leading to much confusion, so that in many cases, named species are but examples of a single form, these names being truly synonyms, and not patronymics. An example is here furnished by the form designated Aster lævis, *Linn* lævigatus, Willd, cyaneus, Hoffm and Pursh described as separate species, now recognized as varieties of an amorphous species, connected by many intermediate variations. Any one of the three may be regarded as the parent stock. Taking the intermediate series we find apparent variations, which, on close examination, fail to establish a well-marked specific distinction. We are justified, therefore, in designating this form by a specific title, which includes the whole group, as is done by Prof. Gray in his Manual, in which priority is given to the Linnæan term lævis, the others representing varieties under this head.

Circumstances like the above are more or less characteristic of all the native species which I have so far examined. I have concluded, therefore, that all well-defined species,—or perhaps I should say true species,—must be looked upon as so many groups, varying individually, yet possessing within each group certain characteristic peculiarities, which, being common to members of each, are sufficient to relegate them from the members of other groups.

I am inclined also to the opinion, "the correctness of which I leave for future determination," that more species are described than have an existence in nature. Observations prove that when passing from the generic diagnosis of the asters, we have, on the whole, few genuine and really natural specific characteristics separating its members.

The difficulty of marking the dividing lines between species in this group of plants arises from their inherent plasticity. Of all feral plants, they have the greater tendency to vary in their natural positions; apparently the slightest change in their physical surroundings tends to produce changes in form, which, though not sufficiently marked to furnish specific distinctions, are yet perplexing enough to severely tax the diagnostic skill of the Botanist who attempts to separate them.

Having on many occasions experienced this difficulty, I have in the following notes attempted to characterise such of our native asters as appear to possess definitive specific peculiarities, and have in the case of each endeavored to relegate them to the group or species described in the Class Book. In this attempt I have relied principally upon the character of the achænia, pappus, and scales of involucrum, and upon the inflorescence, leaves and axis when admissible, the former being in general more reliable for distinctive diagnosis, the latter not so reliable, since, in the very many cases their characteristics are so indefinite as to prove perplexing and abortive as distinctive evidence of specific difference.

The labor may, after all, prove to be a work of supererogation;

nevertheless, any Botanist who undertakes the study of this and some other genera of the great natural order Compositæ, will, I am sure, sympathize with the effort and condone its errors.

Aster radula, Ait.

Stem, 1° to 2°. Angular striate; smooth, purple, shining, branching at the top into a loose corymb; simple below; branches purple, pubescent about three flowered, heads pedunculate large, peduncle naked, involucrum imbricated, five rowed; scales all squarrose, with scarious margins, green centres and tips; obtuse not as long as the disk; rays deep violet, spreading thrice longer than the disk, from ten to fifteen in number; leaves lanceolate, acuminate, sessile, scarcely clasping; alternate remote subserrate dentate; margin scabrous, upper surface dull, dark green, rugous and scabrous; under surface paler; venation reticulated, the veins well marked; pappus simple clubshaped. A fine showy Aster, flowering in July and August, in moist places; varies in its foliage, but the flowers are constant; involucrum bell-shaped; scales regular, close pressed with spreading tips. A distinct specific form, but superficially resembles the next.

A. spectabilis: Ait.

Resembling the above in height, foliage and inflorescence. The scales of the involucrum are however different, being spatulate and obtuse, their margins glandular hairy, giving them the appearance of being finely dissected or fringed. The leaves are narrower, lighter colored, and although netveined, are not rugous. Both species may be easily separated from other forms. They vary less than our other species.

A. Puniceus L. Var viminius. Willd.

Stem glabrous, paniculate furrowed, or striate 2° to 3°; green or reddish on one side; stem leaves narrow; lanceolate taper pointed, remotely serrate dentate; reticulate veined; somewhat auriculate amplexicaul; smooth above and below; edges scabrous; upper

2

surface dark green glaucus, lower paler, 1½′ to 2′ smaller and entire on the branches; branches one or two flowered, heads large, rays about twenty-five, spreading purple, twice or thrice larger than the disk; pappus copious, simple; achænia smooth, scales of involucrum two rowed, outer longer and lax, all green lanceolate acute, as long or longer than the disk, the outer sometimes bract like. A rather handsome species, growing in dark, shady woods or by watercourses, varying much in robustness and foliage according to its situation. In some the branches are supplied with very small leaves, in others they are nearly naked; diagnosis doubtful; answers to puniceus of Linn., but absence of hairs and different character of scales and number of rays, separates it from the typical species; corresponds to A vimineus described in Wood's Class Book.

A. LONGIFOLIUS. Lam.

Smooth stem; terete striate purple; very much branched; branches spreading; many flowered leaves; linear acute entire; the edges scabrous; scales lanceolate, broad, acute, equalling the disk; irregularly two-rowed, loosely squarrose, herbaceous, often bract-like; rays violet, twenty to thirty, showy, very long; pappus simple; achænia smooth; a handsome aster in fields and on road-sides; flowering in September and October; remarkable for its very long, narrow, and acute leaves, which measure from 4′ to 6′ in length by ⅓′ in width; the scales cause it to approach the above, but the entire, very long, narrow, and acute leaves, the longer, narrow, and more abundant ray-florets, and the absence of small leaves on the stems, afford points for differential diagnosis. Synonymous with A. laxus Willd. A. elodes. Torr. & Gr.

ASTER.—Sp.?

Stem striate, simple, leafy, branching at the top; the branches glandular, hairy, and forming a compound corymb; heads numerous, medium sized; involucrum closely imbricated; scales in three rows, erect, narrow, acute, much shorter than the disk, rays all white, twice longer than the disk; fifteen to twenty, disk yellowish or purple brown, pappus equal copious; leaves broad, lanceolate, taper pointed; acuminate gibbous, smooth, with margins scabrous, gradually tapering to a short petiole, entire, imperfectly three-veined, somewhat coriaceous, dark green above, and paler below. A fine, robust plant, very abundant in hilly pastures, forming communities, the only native species observed, with pure, white rays, never varying, except in robustness; the largest of our asters, so far as stem and foliage are concerned; often attaining a height of four or five feet. Although very distinct in form and appearance from the others of this genus, I am unable to affix its specific name, inasmuch as it does not correspond to any species described either in Gray's or Wood's Manuals. It might pass for A. solidaginoides, W. in Eaton's Manual, except for its leaves, which are rather broad, lanceolate, not linear as in the description of solidaginoides, which has only five ray florets; in height and robustness also, it does not approach to our plant. Aster S., of Eaton's Manual is, I suppose, identical with seriocarpus solidaginoides, of Gray's book. I would feel no difficulty in naming it Diplopappus umbellatus, Torr & Gr., to the description of which it corresponds in the characters of its height, foliage, form of inflorescence, scales, and rays, but the pappus of our plant is simple, a character which, it seems to me, would preclude our placing it in a genus, the name of which denotes the presence of a double pappus in its species.

Astermiser. L. Ait.

Stem hairy, terete channelled, reddish purple, from 1° to 3°, branching from below upwards, the branches green, hairy, heads pedunculate racemose secund, sometimes sessile, racemes leafy, stem leaves lance-linear acuminate, dentserrate, feather veined, margins scabrous, 1½′ to 2′ leaves of branches, mostly entire, very small ovate lanceolate involucrum, two rowed; scales erect, lanceolate acute, having scarious margins green centres and tips as long as the disk; rays scarcely longer than disk, varying in colour from white to light violet; heads numerous, occupying the whole length of the branches, a very variable species. "And may include distinct forms." Sometimes simply racemose, or paniculate, or compound. In some the leaves are very small, in others large; the stem simple or much branched; all have dentserrate leaves, minute flowers, and a general resemblance, which enables us to separate them from other asters.

A. Miser. Simply racemose or paniculate.

—— *Var.* Diffusus compound racemose. Mostly inhabitants of dry hill pastures; flowering in Sept.

Aster. *acuminatus.*—Michx.

Stem 1° to $1\frac{1}{2}$°, simple flexuous, somewhat irregular, hairy; branching paniculate corymbose above; branches almost naked; one or more flowered; pedicels having a midway bract; heads large, involucrum, single rowed, often an irregular outer one; scales linear acute, erect channelled; margins and tips scarious; rays about twelve, twice longer than the disk, white with a purple or roseate tinge; achænia smooth; leaves mostly below or at origin of branches, in some appearing to be rosulate, broad lanceolate, feather veined, remotely and irregularly serrated near the long acuminate point, entire towards the cuneate base. Sessile, 2′ to $2\frac{1}{2}$′, veins with scattered hairs; upper surface rough, dull green; inhabits wooded hills, dry and shady places, flowers early—July, August; a species easily distinguished by the characters of its stem leaves and flowers, yet it has apparently three rather distinct forms, one with a zigzag stem, leaves regularly alternate, numerous heads on simple branches, another with the stem also flexuous, but the leaves are crowded at the centre, appearing whorled or rosulate, with simple single or twin-flowered branches springing from the leaves, giving an umbellated appearance, a third more robust than the two former, leaves arranged in general like the second var., but more abundant and scattered; the leaves are also somewhat coriaceous, rugose shorter and narrower than in the others, the heads more numerous and corymbose, the rays more numerous, purple or slaty in color, it flourishes in clearings or exposed situations, while the others flourish best in the shade.

Aster, nemoralis. Ait.

Stem simple or corymbose at the top, leafy, the leaves crowded below the branches, or midway on the simple axis, which is often single-flowered; heads few, branches when present usually single-flowered and naked; stem and branches having short hairs; scales lance linear acute squarrose, margins and tips scarious; rays pale purple or roseate, never white, 15 to 25 in number; leaves narrow, lanceolate, entire sessile; upper surface rugous and scabrous, edges scabrous and revolute, "more revolute in the upper than in the lower leaves; 1′ to 1½′ in some subdentate, lessening from below upwards, an inhabitant of swampy pastures, rather a pretty Aster, generally the first to put forth flowers—July; with a resemblance to the above, it is sufficiently distinct for easy diagnosis from it; they are both included in the div. scariosa or orthomeris, Torr & Gray, differing from Asters proper by their membranous scales.

Art. II.—Mortality Rates of Ancient and Modern Times. By A. P. Reid, M. D., L. R. A. S., etc., etc., *Professor of Medicine, etc., Halifax Medical College.*

(*A Paper read at the Institute of Natural Science, Halifax, N. S., Canada, Jan. 8th,* 1877.)

The idea of our great recent progress is so generally received, that it may be well to take a retrospective glance and see how much in reality has been accomplished.

To get a fair understanding of our subject, let us revert to the period when natural laws were untrammelled, and we had the best examples of health, which, without doubt, prevailed in a very early period of history. We may conclude that the Pastoral Life furnished every sanitary requirement,—good drainage and ventilation, and temperate and sufficient exercise and diet, without facility for effeminate habits. Under these circumstances, it is safe to conclude that, excepting accidents, death resulted from old age.

We must also premise that every individual is at birth endowed with a prospective length of life under favorable conditions, which is measured by the vigor obtained from the parents, modified by a special individuality (for no two members of the same family are alike.)

This natural life may be prolonged or shortened, owing to the conditions to which it is exposed. One person may naturally die at fifty years, from the wearing out of the mechanisms of life. Another dying at fifty may have prolonged his term five or more years by extra care and judgment; and others dying at sixty or eighty may have brought on death prematurely, by five, ten, or more years, owing to debilitating influences.

To take up individual cases as illustration, would far transcend my limited time, and I must deal in generalities.

Presuming, then, that we have a sufficient knowledge of the most favorable conditions of health, we will compare the present with the past.

We find by historical evidence that partly owing to increase of numbers, as well as to the fertility of certain districts, population become more dense, and a nomadic merged into a fixed population.

Deficient drainage and ventilation can scarcely take place when the tent is shifted at frequent intervals; but it is far different with a stationary house, and the gradual collection of excreta and decomposing material, which, conspiring with war or famine, or both, were sufficient to explain the epidemics which have afflicted humanity from very early dates.

As wealth increased so did the desire for conveniences and luxuries, and in time distant countries were laid under tribute to satisfy the demand. This gave rise to the middlemen or *merchants* that increased in numbers and influence as wealth and ability to pay increased.

Arising from the same cause, *manufactures* began to exercise a similar influence, and at the present these combined have massed very numerous populations about convenient centres or cities, giving conditions the very opposite of what prevailed during the nomadic period.

As a result of this, we would anticipate a great increase of disease and death, and such has been the case in every instance where no special means have been used to ward off the ills resulting from a very large population.

These evils are of two kinds, the social and the physical, and though we do not intend to devote attention to the former, yet it must be alluded to, for there can be no doubt but disease is greatly modified by social conditions at either end of the scale ; at the upper end by habits of fashion, ease and effeminacy, and the lower by filth, squalor and poverty.

The physical evils are those induced by an insufficient removal of the gaseous, liquid and solid excreta that are necessarily the result of animal life, and which are the most active agents in producing disease and death in the proportion of their accumulation.

Hence it is not their formation that is prejudicial, but their inadequate removal. By the operation of natural agencies this is easily accomplished in what we may conceive as the natural mode of life—the moveable scattered habitations referred to above.

When artificial customs prevail, so in proportion must artificial means be adopted to carry out the indications of nature, and since we have in latter years gained much knowledge it is to be presumed, if this be turned to account, there should be an amelioration of the general health. Experience has proved the accuracy of this deduction, and the lowered death rate of some cities, notably London, is the best proof, as the very high rate in others shows conversely a deficient attention to sanitary requirements.

One law is thoroughly established, "That the products of animal life are in course of time resolved into inorganic substances which become the pabulum for the growth of vegetable life. But during the transformation above referred to, the compounds that are formed are poisonous to the life of animals unless present in extremely minute quantities. It is necessary that there should be a tolerance of these poisons in the case of animals, or general disease and death would result, and as different species and individuals have different powers of resistance we find that the resulting disease varies very greatly in its types and results, and also that strong vitality may confer. comparative health under very unfavorable conditions.

Another powerful influence that tends to this favorable result is that of *habit*, for we know that so great is the elasticity and endurance of the vital economy that long exposure to a deleterious influence does appear to modify and even arrest its virulence, but in the majority lowered vitality is to be expected with its common result, disease and high death rate.

In comparing the influence of modern civilization on the *General Health* we have two previous eras to consider—the *Ancient* and *Middle ages*.

Our knowledge of ancient times in this particular is very limited, and if what we have received, be correct, they were more favourable than the present. In ancient times, we have three periods—the first when nomadic life prevailed, and we have reason to believe, the best condition were present. Second, that of the Assyrian and Persian Empires.

At these times, we have the gradual accumulation of numerous populations at political centres, with a very high average of health, as a rule, if the Chronicles are to be believed ; and this is easily understood, for the great cities of *Nineveh* and *Babylon* were totally unlike those that have succeeded them, for they covered a vast area of territory in comparison with population.

The original founders also devoted great attention to a complete system of drainage and public baths, as well as the perfect cultivation of the soil, with separate location of the domiciles and very wide streets—precisely those conditions that our most recent knowledge would dictate. These methods, no doubt, prevailed then, more from *military* than *sanitary* reasons, but it would be scarcely just to say that their educated men had not accurate powers of observation, and were not guided by the experience of life that they must have had even then, although their theoretical explanation might not be so accurate as we can give to-day. It is only fair to assume that, at a time when the health and energy of every individual was necessary to the formation of armies, whose success was in proportion to the physical health and endurance of each unit.

(The training of the Persian soldier under Cyrus was perfection as far as our present knowledge teaches.) All reasoning, I repeat, would confirm the idea that the phenomena of health were very closely studied and all arrangements made subservient thereto. Hence it is more than probable that during this long period the standard of general health approached very near perfection, and that our progress at present would be more assured did we very closely copy the methods that prevailed for so many ages long since passed away.

Third, the area of the ancient Roman Empire. Here we had conditions not unlike those that preceded except that there was more crowding with its attendant evils, and we read of plagues that produced great havoc more frequently than in more ancient times. These were generally the accidental results of war, siege, famine and great overcrowding, from the concentration of armies and the inhabitants of the surrounding country, and should not be included in the general health rate which was comparatively high.

The Grecian and Egyptian customs were very similar, and we need not comment on them.

The Middle Ages we may consider as coming down to a late period in the last century, with a health rate comparatively very low in all the great centres of population.

The crowded quarters and ignorance of the most elementary hygienic laws, produced decimating plagues with marked regularity.

The great fire in London in 1666 cut short the epidemic at that time prevailing, by scattering the dense population and perfectly disinfecting the polluted domiciles.

Great wars are always attended by disease, and leave famine and sickness as their result, but in estimating the general health rate this should not be considered, for the unhealthy period just referred to was not very clearly traceable to war but rather to the habits of the times.

During the century just elapsed there are many modifying influences that must be considered in estimating our modern condition.

Commerce and Manufactures, or TRADE, has obtained a pre-eminent position, and controls the massing of populations to a far greater extent than *politics, nationality, or political geography.*

The study of the science of *Hygiene* has made very great progress, and has been able to influence the deliberations of the national as well as the municipal governments, so that the march of improvement is now going on actively, but the course is yet both difficult and long.

Within the past fifty years *trade* has inclined to populate the cities at the expense of the farms, and war has tended so little to diminish numbers, that we have very many centres very thickly inhabited, which, from the vicissitudes of *trade* are alternately in affluence and poverty, and either extreme tends to produce disease.

Hence, we have all that is required to give a very high death rate; and that it is not worse, we must thank the labours of those who, for very many years, have striven to inculcate the requirements of health.

It would be theoretically possible to have most thickly populated and perfectly healthy districts, but since the natural depurating agencies are then insufficient, artificial means must be adopted, proportional to the artificial condition.

Every individual should have abundance at all times of *pure air, pure water, good food, regular exercise,* and no less regular *sleep*, with as far as possible, restriction from indulging the appetite for excesses of every kind.

Sewage, (a convenient term for classing,—the solid liquid and part of the gaseous excreta), cannot be too perfectly attended to, for its influence in poisoning the air and water is supreme.

To accomplish this it is necessary to have perfect removal of dirt of every kind, with such a disposal of the liquids and solids as will enable them to be utilized in nature's way, by vegetable growth, or at least to be disinfected by some means, artificial or natural.

Ventilation is equally as urgent to remove the gaseous excreta of respiration as well as the products of manufactures and sewage decomposition, which must to some extent, obtain, no matter how well their removal may be managed.

As to food, labor, rest and restriction from excesses, they are so mixed up with the conditions of TRADE that at present it is not possible to regulate them by any form of parliamentary legislation. And again they are by no means so prejudicial to the general health rate if perfect cleanliness could be made obligatory.

Zymotic.—Preventable disease, such as Fevers, Dyphtheria, &c., &c., chiefly swells our death rate, and it could be eradicated by cleanliness or perfect ventilation and drainage. While as well those debilitating influences would be avoided that tend so largely to increase the mortality of infant life and those endemic diseases, consumption, malaria and other maladies which are peculiar to certain countries and localities.

To go into the details of these requirements would occupy too much of your time at present, and I will merely refer to the methods sketched by Dr. B. W. Richardson, of London, a most advanced sanitarian, for his model "City of Hygeia," where the most practical indications would be carried out. Its foundation, however, is yet to be commenced.

In conclusion let me say that we have not yet accomplished in any of our cities that which is quite possible, viz., drainage and ventilation, and that our practical sanitary works and general health rate cannot compare with the very ancient and more populous cities of Nineveh, Babylon, or ancient Rome.

It is probable, however, to expect that the vicissitudes of trade will prevent numbers from leaving the pursuit of agriculture and crowding the cities, which vocation alone is practically capable of giving the highest health rate when ordinary common sense and intelligence directs its operation.

ART. III.—NOVA SCOTIAN GEOLOGY, AT THE CENTENNIAL EXHIBITION — INTERNATIONAL EXHIBITION OF 1876. By REV. D. HONEYMAN, D. C. L., *Representative of Nova Scotia.*

(*Read February* 12*th*, 1877)

ABSTRACT.

Nova Scotian Geology was illustrated by my own collection,—altogether Nova Scotian,—and a number of maps.

It was also illustrated in the Stratigraphical collection of the Geological Survey of Canada, and by a sketch map of Nova Scotia, New Brunswick and Prince Edward Island, by Mr. Ells, under the direction of A. R. C. Selwyn, F. R. S., Director of the Survey, and Photos, by T. Weston, Esq., Geological Survey.

I. The collection of Rocks which I exhibited were representative :—

1. Of the "Lower Arisaig Series." *Trans. of the Institute.*

CRYSTALLINE ROCKS.

Laurentian. *Transactions.*
Archæan. *Dana's. Manual.*

Syenites,	From Arisaig, N.S.
"	Mts. George's River, C.B.
"	Cobequid Mountains, N.S.
Diorites,	Same localities.
Granites,	Cobequids.
Gneisses,	"
Petrosiliceous,	"
"	Arisaig.
Jaspideous,	Mts. George's River.
Ophite,	Arisaig.
"	Mts. of George's River.
Ophicalcites,	Arisaig.
"	George's River.
Marbles,	Arisaig.

Marbles,	Mts. of George's River.
"	Cobequids.
"	Five Islands.
Porphyries,	Cobequids.
Amygdaloid,	Mts. George's River.
Diorite,	Arisaig.
"	Mts. George's River.

2. Of the "Middle Arisaig Series." *Trans.*

MIXED CRYSTALLINE.

Cambrian (?). *Trans.*

Lower Silurian (?). *Trans.*

Jaspideous Rocks,	Cobequids.
Petrosiliceous,	Arisaig.
Conglomerates (Ash),	"
"	Cobequids.
"	Scatarie Island, C.B.
Diorites,	"
"	Cobequids,
"	Arisaig.
Porphyries,	"
"	Cobequids.
Amygdaloid,	"

3. Cambrian.

Quartz, etc.,	Halifax.
Slates,	"
Auriferous Quartz,	Waverley.

4. Lower Silurian (?).

Granites,	Cobequids.
Slates (with Fossils),	Wentworth, I.C.R.
Strophomena alternata.	
Porphyries,	"
Diorites,	"

5. Of the "Upper Arisaig Series."

Jaspideous Rocks,	Arisaig Pier.

Aluminous Silicates,	"
Fossiliferous Iron Ore,	Arisaig Brook.

6. Lower Carboniferous.

Limestone (Fossiliferous) with Laurentian Syenite,	Antigonish Harbor.

II. Boulders from drift of Halifax County. *Transactions.* 1875-6 :—

1. Granites,	Cobequids.
Syenite,	"
Diorites,	"
Gneisses,	"
Porphyries,	"
Quartzite (olive, with Crinoids),	"

2. Amygdaloids (Triassic) with

Zeolites,	Five Islands.
Amygdaloids,	Two Islands.
"	Bass River,
"	Parrsboro'.
"	Blomedon.

MINERALS.

Heulandite.
Stilbite.
Natrolite.
Agates.

3. Limestones (Carboniferous),	Windsor and	other localities.
" (Bituminous),	"	"
" (Fossiliferous),	"	"

Stigmaria Ficoides,
Lepidodendron.
Calamites.

This collection was supplementary to the collections which I had in the London Exhibition of 1862, Dublin, 1865, and Paris, 1867. It was intended to illustrate investigations made by myself since the Exhibition of 1867. They have all been submitted to the Institute.

(*Transactions*, 1869-76.)

I also illustrated the Geography of Nova Scotia by a portfolio of maps.

1. A new geological map of Nova Scotia and Cape Breton.
2. Map of Cape Breton showing localities examined.
3. Geological map of Antigonish County.
4. Geological map of Arisaig.
5. Map shewing the arrangement and character of the pre-carboniferous rocks of East Pictou.
6. Geological map of the pre-carboniferous rocks of East River, McLellan's Mountain and Sutherland's River.
7. Map of Colchester County, chiefly illustrating the geology of the I. C. R. and Cobequid Mountains.
8. Map of Cumberland County, chiefly illustrating the geology of the I. C. R. and Cobequid Mountains.
9. Map, showing the geological formations on the Grand Lake and Railway.
10. Admiralty Chart of Halifax Harbour, geologically coloured.
11. Map, illustrating the superficial geology of Halifax.

Stratigraphical Collection of the Geological Survey.

I.—In the *Laurentian*, division No. 199, 277, are specimens from George's River, Kelly's Cove and Cape Dauphin, in Cape Breton.

The specimens from George's River are like those in my own collection, excepting the ophites, ophicalcites and jaspideous rocks, which are wanting in this collection. I regard these as a characteristic part of the series. I have referred to St. Ann's in more than one of my Papers to the Institute, as showing by specimens that the Laurentian existed there as well as at Arisaig. This is connected with Kelly's Cove and Cape Dauphin. In regard to the age of the Cape Breton representatives of my "Lower Arisaig Series," the views of the survey collection correspond with my own.

II.—In the *Huronian* and Lower *Cambrian* divisions are, first: Nos. 395, 416, from Louisbourg, C. B., and second: Nos. 417, 425, from Jebogue Point, Yarmouth, N. S. The Louisburg specimens, correspond with the Scatarie Island specimens of my collection. They are regarded by the survey as of Huronian age. I have regarded my specimens from Scatarie, C. B.,—the rocks being a part of the Louisbourg series—as corresponding with my "Middle Arisaig Series," of Arisaig and the Intercolonial Railway. The I. C. R. rocks I have regarded as corresponding with certain Lower Silurian rocks of Wales, described by Professor Ramsay. Trans. 1874–5.

In the Catalogue of the Geological Survey, we have a note on the Jebogue rocks:—"The rocks of Jebogue Point and Cape St. Mary seem to be lower than the gold-bearing slates and quartzites (whin) in the same neighbourhood. Catal. 141.

Lower Cambrian.

Atlantic Coast, specimens 426, 450. These are from the auriferous rocks of Nova Scotia.

Note.—"Supposed to represent either the base of the Primordial or the Lower Cambrian series." Catal. 141.

III.—Lower Silurian, No. 461. From the Granite Junction, Halifax. Nos. 462, 476; Bras d' Or and Cape Breton.

The specimens from Bras d' Or contain Lingulæ. They are considered by Mr. Selwyn to be of Potsdam Sandstone age.

IV.—Middle and Upper Silurian, Nos. 736, 53, are from Arisaig, Frenchman's Basin, East River, Malignant Cove, Doctor's Brook, McLellan's Brook.

I would observe that the rocks of Arisaig Pier and Cove, Frenchman's Barn and Doctor's Brook correspond with No. 5 of my collection; *i. e*, with A. of my "Upper Arisaig Series," viz: Jaspideous rocks and Aluminous Silicates. These were first recognized at Lochaber and then at Doctor's Brook, by my own observations. They are older than the *Lower Arisaig or Clinton of Dawson.* Others are pre-carboniferous.

The rocks, at East River, are Middle and Upper Silurian, at

McLellan's Brook, they are of same age. The rocks at Malignant Cove are Lower Carboniferous, conglomerates with intrusive Trap. Laurentian lies east of Cove. *Vide* sections in "Geology of Antigonish Co." Trans. 1874–5.

V.—Devonian. Iron ore with Fossils. Nictaux Granites, Nos. 781, 804.

The Fossils in the iron ores of Nictaux are considered by Mr. Selwyn, Dr. Dawson, Prof. Hartt and others, to be of lower Devonian age. In fact the rocks containing these ores are at present regarded as the only unquestioned representatives of the Devonian Formation in Nova Scotia.

The relation of the Granites, occurring at Nictaux, to the supposed Devonian Formation is considered as demonstrating the Upper Devonian age of the former, and also of the Granites associated with the Gold Fields of Nova Scotia. Accordingly specimens of these granites were arranged in this division of the collection.

VI.—Carboniferous. Lower Carboniferous, 805 to 821. Mill stone Grit and Coal Measures, 225 to 839. Upper Coal Measures, 840 to 843.

This extensive, interesting and beautifully prepared collection, with the exception of the first 138 specimens, has been presented to the Smithsonian Institute at Washington. A geological map of the Lower Provinces, coloured by Mr. Ells, of the Survey, under the direction of Mr. Selwyn, was also exhibited, showing the supposed course of the Laurentian axis from Cape North, through Cape Breton, through Arisaig, N. S., Pictou, and the Cobequid Mountains, and through New Brunswick; also the supposed Devonian Granitic axis from Cape Canso through Guysboro' Co., Halifax Co., Lunenburg, and Shelburne, Annapolis, &c.

Photographs.

There were also exhibited 21 beautiful photographs from well-selected positions, illustrating the geology of the "Upper Arisaig Series" and the succeeding Lower Carboniferous Formation, as exposed in sections on the shore on either side of the Antigonish and Pictou County line, *i. e.* from Doctor's Brook to Mill Brook. These were photographed by Mr. Thomas Weston, of the Geological Survey.

Addenda.

Geological Gleanings from the Economics.

1. Laurentian.

Syenite from George's Mountain, C. B. Exhibitor—James McQuarrie.

Syenite from Campbelltown, C.B. Exhibitor—C. J. Campbell.

Marble—polished; white and mottled, from Marble Mountain, C.B. Exhibitor—J. Silver.

Green Breccia, polished; from Scatarie Island, near Louisbourg, C.B.

2. Cambrian.

Block of Gneiss (Ironstone) from Halifax.

Auriferous Quartz collection. Honorable Robert Robertson, exhibitor.

3. Lower Silurian?

Blocks of Granite. Halifax—Shelburne.

Lower Silurian.

Iron Ore from Whycocomah, C. B.; Red Hematite, East Bay, C.B.; Calchopyrite, Copper Ore, Polson's Lake. W. Ross, exhibitor.

Calchopyrite, from Lochaber Lake, N. S. James Hudson, exhibitor.

Middle Silurian.

Fossiliferous Iron Ore, Blanchard, East River, Pictou, N. S. Crawford and Gilpin, exhibitors.

Fossils *Athyris* in this ore, characteristic of the Mayhill sandstone, *Salter* or *Medina* sandstone, U. S., have led me to regard the bed as lower than *Clinton;* but as this member of the "Upper Arisaig Series," at Arisaig, and other localities, has only a thickness of 250 feet, I am disposed to regard the bed as lying in the *Clinton* and to regard the *athyris* as ranging higher than A of the Upper Arisaig Series.

Limonite, East River, Pictou; Specular Iron Ore, East River, Pictou. Exhibitors—Crawford and Gilpin.

These Pictou ores seem all to be confined to the *Clinton*. *Vide Transactions of Institute.*

MIDDLE AND UPPER SILURIAN.

Brown Hematite, Londonderry Mines, N. S.
Red Hematite, " "
Specular Ore, " "
Yellow Ochre, " "
Ankerite, " "

Exhibitors—Steel Company of Canada.

The Strata containing these ores belong to the " Upper Arisaig Series," but do not seem to contain fossils. They may therefore be either Middle or Upper Silurian.

Limonite, Brookfield, N. S. Exhibitors—Advisory Board of Nova Scotia.

Devonian?

Iron Ores, Cleveland Mountain, Annapolis, N. S. Exhibitors —Stearns and Page.

5. Carboniferous.

Gold in carb. conglomerate on slate, from Gay's River. Exhibitor—H. S. Poole.

Building Stones. Exhibitors—Advisory Board.

Grindstones and Whetstones. Exhibitors—Seaman & Co.

Gypsums. Exhibitors—Advisory Board.

Limestone.

Blocks of Coal. Nova Scotia and Cape Breton.

Pyrolusite, Manganese Ore, Tennycape, N. S.

Spathic Iron Ore, Sutherland's River, N. S.

The Manganese ore is from Lower Carboniferous Limestone. It occurs in large *pockets, masses* and *nodules* in the Limestone.

Triassic?

Magnetic Iron Ore. Exhibitor—D. Chipman.

This occurs in the Triassic trap at Five Islands, Blomidon. North Mountain, Digby.

It contains Amethystine veins, Jasper, &c. In the mineralogical collection exhibited by H. S. Poole, Esq., were specimens of native copper, which also occurs in veins in the same trap rocks. These metallic deposits have not been found to be of economic importance. The trap of this Formation is celebrated on account of its cabinet minerals. Every museum of importance in the United States has specimens of the trap minerals of Nova Scotia.

ART. IV.—INDIANS OF NOVA SCOTIA. BY J. BERNARD GILPIN, B. A., M. D., M. R. C. S.

(*Read 12th March*, 1877.)

I HAVE thought it desirable to put upon record in the Transactions of the Natural History Society, all the facts I could obtain, either personally or from old and living authors, concerning our native Indians. The time is rapidly passing,—indeed, has now passed, for such a purpose. I may not produce any thing new; but if I only put old things, scattered in many books, manuscripts, or in traditions, into one record, I shall have done as much as I expected to do. The books I have had access to, by the kindness of my friend, Dr. Akins, have been early copies of Cartier, Champlain, and LesCarbot, and Charlevois,—all eye-witnesses, except the last. I have also had access to all the manuscript documents belonging to the Record Commission of Nova Scotia, from seventeen hundred and twenty-four, nearly to our present time, including the Indian book of the late Hon. Joseph Howe. These, with occasional pamphlets issued from time to time, my own personal recollections, traditions, and Murdock's History of Nova Scotia, are the sources from which I have drawn. This latter gentleman has drawn largely from "Relations of the Jesuits, Quebec."

Our first exact account of the Indians of Nova Scotia is found in Les Carbot, 1609. Earlier mention is made of them, however, in Jacques Cartier, whose first voyages were in 1534. We find that as early as the sixteenth century the shores of Nova Scotia were frequented by fishermen of various nations, and in greater numbers than is usually supposed. Baron de Lery visited Sable Island as early as 1518. Savelet in 1604, had made forty voyages from France; a voyage and home being then about one year. Thus, when Les Carbot gives us his minute descriptions, from two to three generations must have passed since the Iron age had commenced its operations on the races of the Stone period. Iron knives and axes, the steel and flint, with its great powers of carrying fire everywhere, and coarse potteries and beads, must have begun already to modify their habits. The ancient arrow-maker must have ceased his art; the son must have used an axe foreign to his father, and the squaw to ornament her skins with French beads instead of small shells. The first name by which they were called by the French is Souriquois or Sourique. This name seems almost identical with Irequois, Arromouchequois and Algonquin. It is probable the Mic-Macs, as we now call them, were a set-off from the great Algonquin race, who extend from Canada to the extreme West; but set off for so long a period of time as to lose a common dialect. Whilst our Indians from the earliest date used the language common to Canada, they could not understand the Armouchiquois, or those who lived in what is now called New Hampshire and Massachusetts. In the year sixteen hundred and nine, the French living at Port Royal, Nova Scotia, estimated their numbers between three and four thousand souls. This included Cape Breton and Prince Edward Island. This, by the usual calculations, would make between five and six hundred adult or fighting men. They were clothed in skins of bear, otter, beaver and fox, and the larger skins of elk and deer. They had learned the art of softening and taking the hair off the larger ones. In Summer their clothing was a girdle around their waists, on which was fixed a skin that went betwixt the legs, and was attached again to the girdle behind. A cloak of skins was hung around the neck, with a loose cape hanging back from the shoulder. Usually the right arm was exposed. In winter they made sleeves of beaver skins, tied at the back, and long hose of the same, tied to the girdle around the loins, and their feet were covered with a buskin of untanned leather drawn into plaits in front, the present mocasin. The women wore the same dress, with the exception of a tight girdle around the cloak. In camp the men wore nothing but the waist leather. They had no covering for their heads, using the loose cape of their cloaks as shelter in winter. The hair was worn long, cut short in front and sometimes trussed on the top or behind by a feather or pin. For ornaments they seem to neither have been painted or tatooed, but to have made strings of black wooden beads and pieces of white shells. The quills of the porcupine were also dyed with bright colours and formed into plats and squares. The men cared but little about these things, but they wore knives at their breasts. These people, thus clothed, lived in movable wigwams, a conical tent made of birch bark fastened around poles tied at the top, and at the bottom encircling an area of about twelve feet diameter. During summer they pitched them at the sea side or on the lake borders; in winter they retired to the forest. In the short summer they lived upon fish, and during the long winter when the fish had retired from the shore, they hunted the elk and reindeer. They, when at war and expecting an attack made a pallisaded fort, by taking a square of living trees, thickening up the spaces with poles and brushwood and leaving but one place of entrance, and building their camps or wigwams within it, thus contriving a rude fortification. In a print of the period from Champlain, of the pallisaded forts in Canada, the structure is much more elaborate, and built of hewn timber, but LesCarbot distinctly asserts that our Indians never felled trees, not even for fire wood. The few household utensils they possessed were of wood, stone and horn, or bone. They had pots of a very coarse baked pottery, and stone axes and mallets, knives and gouges. Deers' horn and bone were also used, and from a recent deposit at Lunenburg we find copper knife blades and needles made from the native copper of the Bay of Fundy, hammered into shape. They also had the beautiful racquet or snow shoe, that has come down to us unaltered. These simple utensils, with their skins and furs and the boat, or canoe, that transported them from sea coast to lake side, formed all their wealth. They had already acquired the habit of smoking, and though they did carve their pipes sometimes into forms of animals, yet the usual pipe was a stone hollowed at one end into a pan, into which they stuck a quill or hollow reed. In their wars they used clubs, bows and arrows, and shields, and lances or spears headed with stone. These wars were carried on with much forethought and energy. Membertou, the old Sagamos, at Port Royal, brought men from Miramichi and St. John's river, and made a rendezvous with his own from Nova Scotia, at Grand Manan, before attacking the tribes that resided in what is now called Massachusetts. They brought home the heads of their enemies, which they enbalmed and hung them about their necks in triumph, but there is no mention made of scalping.

As they had no letters they could have had no laws, save traditions. The Sagamos usually settled all disputes. A man of many friends was unmolested, for he had many to avenge him, but a slave or a prisoner with no friends fared badly. Polygamy was allowed rather than practiced, and though they had little regard for chastity yet there seems to have been no jealousy among them. Their care for their parents, fondness for their children and general hospitality must make all amends.

As regards religion, an obscure belief in some future state was their only creed, some Medicine men their only priests. And now we can form some idea of these men of the stone period as they were about insensibly to fall beneath the iron age. A well fed, light footed, clay-red race, with beardless face and shock of black hair, fish and flesh eaters, reaping no harvest save from forest and sea, having neither letters or laws or settled habitations, yet either in friendship or war having relations five hundred miles at least with their neighbors on either side.

This is not an unpleasant picture of man in his stone period. With no laws but those of superior strength, they got on very fairly in their social relations. With no church or religion they were hospitable to their neighbors, kind to their wives and children, and very careful of the old. "One thing I will say," says Mark LesCarbot, "that belongeth to fatherly piety, that the children are not so cursed as to despise their parents in old age, but do provide for them with venison." But it strikes one through all these narratives that life was hard to keep up. The severity of the climate, the long winter for which they could make no provision, and their inability to cultivate the soil, always kept their numbers few. They made no accumulations, and have left no records of the past save a few stone weapons and shell mounds.

Further south where a sunnier sky brought forth the maize and the bean, there the same race grew in numbers and strength, and became so powerful as to repel the Frenchmen who themselves would gladly have made their settlements to the southward of Nova Scotia.

This ends the first stage, the stone period, or prehistoric age of our Mic-Mac. About two hundred and seventy years ago, or the beginning of the seventeenth century, the age of Iron came down upon them. They came under the influences of the French, who held them for one hundred years, and whose kind and mild Government may be called their French age. During this period they must insensibly have cast off their coats of skin and clothed themselves in woollen clothes. They ceased to war with themselves, they pointed their weapons with iron instead of stone, or exchanged them for muskets, but they still remained living in wigwams, wandering from sea to forest, and generally connecting themselves with the French fishing stations and ports, where they bartered skins and furs for bread and tobacco, and other things which they were fast learning to call the necessaries of life

We have no records of this period, but from incidental remarks from time to time of various writers, we learn that the kind relations existing from the first betwixt them and their masters, never altered.

When a female prisoner stole from the Sagamos, Membertou, an axe and tinder box to facilitate the escape of another captive, she was condemned to die. The women of the tribe led her to the forest and there killed her, the king's daughter, a comely maiden, striking the first blow. The French officers, to show their disgust, ever afterwards refused her as a partner at the dance. This anecdote shows the iron age as a reformer, yet something may be said for the stone, where men would not kill women. They may be said to have accepted the Christian faith rather than to have been converted. They had no faith to turn from. The Fathers of th Reecollet and the Jesuits vied with each other in teaching the doctrine of the Roman Catholic Church. On St. John's Day, June 24, 1610, twenty-four or five of the Indians were baptized at Port Royal, among whom was Membertou, then one hundred years old,—his great namesake, Henry of Navarre, having fallen but a few weeks before under the assassin's blow. To the present day they have been faithful to that church whose simple dogmatic teaching and splendid exterior so well supplies their religious wants. Of such importance was this event considered, that a special messenger was sent to France to announce it; and again we meet with a royal letter of the great Louis XIV.'s, enjoining upon the governor, their religious care.

Baron de la Honton, 1696, says (Murdock): "The French neglect nothing to secure the Indians, giving some notable men pay as a lieutenant or ensign, and giving them rewards for mischief to the English, or to the Indians in the English interest, paying them for scalps, sending the Canadian youth with them, or giving them commissions,—taking Indians to Europe to show them the glories of the French Court and armies. There are now at Versailles six Sagamos from Canada, Hudson's Bay, and Nova Scotia."

Thus, kindly and gently the French held our Mic-Macs for one hundred years. In seventeen hundred and ten, Soubercase, the French Governor at Port Royal, now Annapolis, surrendered it and all Acadie to the English. From that date French government ceased, as regards our Mic-Macs, from amongst them. The cruel Indian wars that had been raging for more than fifty years so near them, and so cruel, that it has been said that there was no man of forty but had seen twenty years service on the borders of New England, was now to set in upon Nova Scotia.

After the conquest of Nova Scotia, the English Governors held but feeble sway at Annapolis, and their out-ports at LaHave, Horton, and Canseau. The neutral French played into the hands of the openly hostile Indian, and they were both influenced by the French Governor of Quebec. The lives of the English governors seem to have been perpetually harrassed by the Indians, who were excited to their acts by emissaries, chiefly from Quebec. M. Gaulin, missionary, (letter from Placentia, 5th September, 1711, Murdock), boasts, " To take away all hope of an accommodation, he induced the savages to made incursions upon the English." During this same year an ambuscade of Indians destroyed the whole force of eighty men, killing outright thirty men, the fort-major and engineer, and making the rest prisoners. This happened twelve miles up river from the fort, and so encouraged Gaulin that he immediately invested the fort (Port Royal) so closely that the garrison could not appear upon the ramparts. This garrison is said to have lost in seven months, by sickness and sorties, three hundred and fifty men. Surprisals also were made by the Indians on fishing vessels and fishermen on the sea coast,—at Yarmouth, at LaHave, and at Canseau. Few people now imagine the terror of their name at that date, or fancy that a few scattered savages could do so much mischief. "Queen Anne may have the meadows, but we have the forest, from which nothing can drive us," was their open boast, as well as the reason of this power.

Their inroads seem to have been made from with varying frequency, from seventeen hundred and ten to seventeen hundred and sixty-one. They languished for awhile; but when it was seen by the French that England, by the founding of Halifax, was in earnest in settling the Province, they seem to have increased. Annapolis was again invested by the Indians, and a sergeant and two men killed. Another missionary, not Gaulin, but Laloutte, the darkest figure of the many dark men that vexed the times, boldly led the assault of his French and Indians, against the crumbling walls of old Port Royal, then defended by the veteran Mascarene. Unsuccessful, stained by the murder of Captain Howe, denounced by the French officers, and by his superior, the Bishop of Quebec, he disappeared from the scene, tradition says, to die a life-prisoner in an English fortress.*

* It must be confessed as a strange irony of the times, that the grand wars of tho French were fought over in the pine forests of Nova Scotia between Huguenot and Catholic. Whilst Gaulin and the Jesuit Laloutte led on their petty tribe of savages, the Huguenot Mascarene stayed up his ragged soldiery. This gentleman, banished by the revocation of the edict of Nantz whilst yet a child, from France, found himself

Dartmouth was also assaulted, and murders and robberies committed at Windsor and other parts. The Governors were of late in the habit of taking hostages for their good behaviour, which kept them quiet for some time. One of these poor fellows, who had been a hostage for two years about the fort, was shot and scalped by an order in council, amongst whose members sat that merciful officer, Major Mascarene. This cruel anecdote shows strongly the dread and fear these Mic-Macs must have caused in those times, as well as their power.

Haliburton says of these times: "The number and ferocity of the Indians, and the predatory habits in which they indulged, rendered them objects of great attention and concern to the local government."

In seventeen hundred and sixty one a formal treaty of peace with the Indians was signed at Halifax, and the hatchet buried. Quebec having already fallen, the Treaty of Paris (seventeen hundred and sixty-three), crushed for ever these bloody scenes.

In looking over the manuscript documents relating to the Indians, now in the Record Office, we find the several treaties at Casco, Maine, at Halifax, and again at Halifax, with one Francis Mius, who held the chieftdom of LaHave, under brevet of Chevalier Duguesnol, Governor of Cape Breton. In these the Indians are treated as powerful bodies, presents are made and hostages exacted. A few years pass, and treaties change to humble petitions. They are beggars now,—wandering families, and the principal papers are certified accounts of powder, shot, tea, tobacco, pipes, blankets and meal, supplied them by government, from time to time.

In eighteen hundred and one, in reply to a committee of the House of Assembly, a return of their number was sent in as eight hundred and fifty. These returns are incomplete, not including Cape Breton, Yarmouth, and Annapolis. These manuscripts are

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a soldier of fortune and Captain of Grenadiers in a New Hampshire regiment, entering, as he himself says, Port Royal at the breach. His after command of that place shows him a fair match to his enemies, in courtesy, in courage, and craft, and in good French. Now nearly taking off Laloutte's head by a lucky cannon shot; now allowing provision to be sent to the starving garrison at Louisbourg, (he had had a butt of claret from old Dugnesnol), and then answering the Archbishop of Quebec in French as fair as his own.

varied by the different writers' remarks. Edward Irish, Dorchester, says: "In getting new blankets, they made breeches and stockings by cutting up the old ones." This fact was verified by Charles Glode, about eighteen hundred and thirty-three, using strips of blanket for stockings, when in the woods with myself. G. Oxley, Cumberland, says: "I knew no heads of families addicted to drunkenness to any remarkable degree, nor any but will be drunk when opportunity affords." This truthful remark remains good yet. Joseph Marshall, Guysborough, says: "Very little in their huts to subsist on, and as little on their persons to shelter them." The government had spent £550 in one year upon them; but two years afterwards we find them curtailing their grants "to the young Indians roaming to Quebec, when hard-working white men at Halifax were supporting families at three or four shillings a day." In eighteen hundred and seven, the year of the *Chesapeake*, American frigate taken by the *Leopard* in time of peace, on an alarm of an American invasion, these wandering beggars were again the objects of alarm.

The Province was divided into twelve Indian districts. Mr. Monk, afterwards Justice Monk, was appointed Chief Indian Commissioner, who communicates to the twelve deputies, whom he hopes will give gratuitous information "in the hour of alarm." He had also the power to send confidential agents or spies to live among the Indians.

In Judge Monk's report to government, he places the fighting men at between three and four hundred, says there is much war talk among them; that deputations had been sent to Canada, and that American agents were making great war talk about them; that generally the feeling was neutral; that they would wait to join the strongest party; except the Indians of Pictou, who would accept nothing from government, but would scalp all the pale-faces in two nights; and those of Sable River, who had assembled in large numbers, had menaced the Shelburne Indians, and insolently refused to explain their meetings; that in Cumberland they would fight for King George, and that in Cape Breton the feeling was similar with Nova Scotia. He also suggests that the twelve districts should choose a chief who would communicate with the government, and that the influence of the Catholic clergy, who were very well disposed, should be sought.

These various papers, all much decayed, and many dirty and pocket-worn, are endorsed by Governors Wentworth, Prevost, and Sherbroke. The strong, bold hand-writing of the latter, with the initials J. C. S., are very characteristic. Louis Toney and Peter Maurice, to their honor be it told, offer to fight for King George. This petition is dated eighteen hundred and twelve.

From memoranda of Sir John Sherbroke, we gather that they were never called into service. He orders them to be clothed, but arms and rations are nowhere to be issued. There are persons still living who remember seeing two hundred in one body at Shubenacadie at that time, and Indians not long dead who boasted of being captains then. To us in the nineteenth century, their being cause of alarm seems more strange than their ingratitude, after being fed for one hundred years. Petitions for grants of land now appear. Reserves of one thousand acres in various parts of the Province and in Cape Breton were surveyed. The Francis Xavier settlement at Bear River, Annapolis, seems to have been the most successful, under the joint care of Mr. Justice Wiswell and the Abbe Segoigne, in eighteen hundred and thirty-one. There are several letters of this excellent gentleman preserved.

In eighteen hundred and forty-two a commission was issued by the Lieutenant-Governor, Lord Falkland, appointing the Hon. Joseph Howe, Indian Commissioner; and from his report, dated eighteen hundred and forty-two, we learn their numbers at that time to have been fourteen hundred and twenty-five.

Mr. Howe, from statistics received, says the numbers at Pictou in seventeen hundred and ninety-eight, were eight hundred, and calculates their decrease by it; but Mortimer's list to House of Assembly for eighteen hundred, makes them only one hundred and thirty-six. Mr. Howe's book contains his own report, a separate plan of each reserve of land for the Indians, being in Nova Scotia proper, ten thousand and fifty acres, and in Cape Breton, twelve thousand; numerous letters from various individuals, and ends in eighteen hundred and forty-two. He seems to have entered into the work with his characteristic force and with personal observation.

Here ends the records; but doubtless there are other papers between this date and the confederation of the Dominion, at which time Indian affairs were handed over to it, still in the public offices.

My first knowledge of the Indians began in eighteen hundred and thirty-one. At that period they all lived in neat birch-bark wigwams,—a house was a very rare exception; and they all, both women and men, were clothed in coarse blue cloth. The men in blue frocks with scarlet edges upon the shoulders and on the arms. A scarlet or gay-colored sash bound this to their waist, at the back of which hung a tobacco pouch of moose skin. They wore also knee-breeches and long gaiters of the same blue, with the selvage edge left long, and ornamented with scarlet. The stocking was a long roller of blanket, wound from the toe to the knee. A large silver brooch of the size of a large watch, usually held the frock at the neck; and the foot was covered by an untanned mocassin. The hair was worn very long. A beaver hat on great occasions, but usually a straw hat or red cap surmounted a huge mass of unkempt locks.

The women wore a high-pointed cap of blue cloth, often ornamented with scarlet cloth and white beads; a short gown and petticoat reaching to the knee, with a gaiter trowser, and the selvage left loose to the ancle. In cold weather a blanket was worn over the head, and always brought square across the back.

This pleasing dress, in which we recognize the hunting frock of all North America, whether it be the deer-skin shirt and leggins, with their fringes of the far west Indians, or the frock of the old continental rifleman, we infer was their habit from the time they ceased to wear skins. The continual mention of coarse scarlet and blue serges by the French, the bales of blue cloth in the English treaties, and the bills of the same furnished to them by government in our own times, are ample proof.

The gaiter is the old housen of Les Carbot with its uncut fringe, and the scarlet epaulet or wing the "Matachias" of the same author; or ornaments of quills, where the "good beaver slieves" goeth into the cloak of skin.

In "The Frontier Missionary" we have a graphic sketch of the Indian of his day, 1779, at Halifax: "He had many Indians in his train," speaking of Lieutenant-Governor Franklin, "arrayed in all their tinsel finery, amongst whom was a Sachem, who wore a long blue coat adorned by a scarlet cape and bound closely about his loins by a girdle." This is proof of his dress one hundred years ago.

In 1831, when I first made acquaintance with them, this blue hunting frock, scarlet epaulet, and gaudy girdle, and long gaiter for the men, with blue pointed cap, short petticoat, and gaiter, with blanket always worn *square* on the back, for the women, was their universal wear. Les Carbot says expressly, the skin cloak was worn square, so they have adhered to this form through skin and serge and two hundred and fifty years.

I have now brought the Mic-Mac from his Stone or pre-historic age, his French age, and his English age, to our own times, and it remains to give his present condition. Estimated in early French times at about between three and four thousand souls, and that including Prince Edward's, we find them at the next authentic record (Judge Monk's return, 1808) as from three hundred and fifty to four hundred fighting men. This would make about two thousand souls, making a decrease of something more than fifteen hundred in two hundred years. In 1842, Mr. Howe returns them at fourteen hundred and twenty-five. The last census makes them:

Halifax	158	Annapolis	68
Lunenburg	50	Kings	61
Queen's	110	Hants	168
Shelburne	28	Cumberland	44
Yarmouth	37	Colchester	31
Digby	224	Pictou	125
Antigonish	81	Guysborough	48

1233 N. S.

Cape Breton—

Inverness	138	Victoria	69
C. Breton	188	Richmond......	78

473 C. B.———1706 Total.

Thus we find from census returns they are rather increasing. This is owing in part, perhaps, to the census being more correct; but there are other causes that may contribute. Within the last fifty years a greater change in their dress and habits has come over them than when they passed from skins to serge. With regard to the men, the blue hunting frock and gaiter with its scarlet seams have entirely disappeared. The men dress in ordinary clothes, but usually affect a grey tunic and pantaloons, with shoes or high boots. The high pointed cap and short petticoat lingers a little amongst the old women; but hats and feathers, veils, flounces and high laced boots are rapidly taking their place. Though the artist must mourn, the wild graceful figure lost in the modern navvy, yet no doubt the change is beneficial. Anything that lessens the separation between them and the dominant race into which they must sink, hastens the hour. Another change in their habits is telling greatly upon them, they all now have permanent winter houses. If they do not sleep in beds, they at least sleep on floors of wood during the cold winter, instead of on the hard ground covered by spruce bushes.

Their summer camps are still as of old. Clothed like ourselves, with a boot keeping the feet dry, and sleeping warm and dry, they cannot retain the old instinctive adhesiveness of race, or the ancient consumptions and palsies that formerly decimated them. Ever minding all these changes and these ceaseless influences on their moral and physical condition, we will describe the Mic-Mac Indian of the present hour. His stature is below the medium; slight, carrying his shoulders overhanging forward and high; his limbs light, and extremities small; the tibia or shin bone well curved, but this curve is high in the bone and forward as well as outward, and springing as it does from the high boney arch of a very clean instep, has the grace of fitness and beauty which is not found when the curve is near the ankle and the instep flat. This beauty which was formerly brought out by the tight gaiter and moccasin, the fisherman's heavy boots is fast destroying; and the loose trouser with its baggy knees hiding from sight. He is beginning to turn his toes outwards. Even the Indian squaw who once stole so softly on you with her parrot-toed foot, fringed to the ground like her native grouse, now flaunts with outward toe, a crimson topped high laced boot. He wears his hair cropped now, which brings still more in relief the small and narrowed skull, high and broad cheek bone, high frontal ridges, and square heavy jaw bone of the red man, or Mongolian type.

If we look in the children and women we find the oblique eye of the same race; but in the adult the continual exposure has caused the muscles of the orbit drawing and puckering around the eye for its defence, to draw down the corners. The nose sometimes approaches to the Roman, but always has wide nostrils; the mouth large with the upper lip convex, and the chin retreating.

In the women and children the mouth is the worst feature, being large, unmeaning, and often open,—the greater force in man giving it stronger expression. The eye is dark, oblique and small, and rather intelligent than bright. The French called their colour olive. This now could scarcely be true. We miss the richness of the olive. The men were almost a clay yellow, and it is only in the women and young we find a reddish tint or coloured lip or cheek. The beard is scanty, a small moustache and a few hairs on the point of chin. Such is the description at present of the Stone man of two hundred and fifty years ago,—how little changed in habit or feature. The ceaseless influences of civilization, of different food and altered habits, have worn down and softened his contour. The high cheek bone is lessened, the strong jaw is less square, and the wild aspect of savage life softened. He has ceased to tear his meat like a dog, therefore the square jaw is more pointed, and the cheek bone, which is only a bridge for the jaw and its muscles to play beneath, has fallen; nor has he the wild utterance or startled look of one always fearing his enemy.

Recollecting that these changes are as ceaselessly working upon ourselves, we cannot but marvel at the strong cohesiveness of race that has kept him so little unaltered. Give him back his well stored forest and stream and one generation would obliterate his whole civilization.

It is generally said our Indians are changing from mixed blood. No doubt there is some truth in this, as the white names continually occurring amongst them prove; but as far as my own researches, principally amongst the western families, have reached, I think this is only by illicit intercourse,—the child taking the name of its father. I never saw but one Indian with a white wife, and I have only known two white men living amongst them. One of them was married. I saw one negro, whose half-breed child showed so many signs of unconformability of races; and as I have never met her afterwards, or but a single trace of her descendants since, I think the cast has died out. The Indians themselves remarked it. "Me tink," said old Molly to me, "Indian squaws with wool, nasty, nasty."

The Biologist would have been equally disgusted, but would not have failed to note the Mongolian and Caucasian were more nearly allied than the negro.

These remarks are based upon the Nova Scotia Indian, as we know from the statement of the late Colonel Chearnley, Indian Commissioner, that a race of half-breeds between the French and Indians of Cape Breton, were rivalling both parents in stature and habits. Yet it must be confessed that a lighter colour, a tendency to fatness, especially in the women, and a smoothness of contour as regards form, and a loss of that so pleasant scanty tongue (the words dropping out so unwillingly), is stealing amongst them.*

* These observations are made principally from the idle groups of men, women and children hanging around our country villages, or their own summer camp. Yet, it is but fair to the Indian to say that, seen in the forest or in the hunting grounds, all the old instincts of his race start out, clothed though he may have been in skins, blue hunting frock or grey trowsers,—his exact knowledge of localities, day or night, his keen observations of all animal signs, and his power of forming rapid and true conclusions from them. Unlike white men, he never works lazily, although off work none can excel him in it. He tracks his game with all his might,—eye, ear, foot, touch, is strained to their utmost intensity. His pose, shooting porpoise from his frail canoe, is a study for an artist. Such seemingly careless repose, such nice balancing,

Whether from cross-breeding or the ceaseless efforts of new circumstances, the grey loose trowsers, heavy boots, cook-stove and dry bed, will rapidly accelerate all these changes. It seems now by the census returns, they have a slight increase; yet the fewness of children amongst them too surely proves a doomed race. From the many returns of now nearly one hundred years, and my own observations, to allow three children to one family is a very high estimate. In some counties two, or two and one-half, was nearer the truth. The very early marriages of thirteen or fourteen years may conduce to this, as though many die in infancy, fewer are born than amongst the whites.

The race between change of habit and existence, will end in existence, marking the score. They will die out as Mic-Macs. They have ceased to be forest hunters. No Indian lives by the chase, and although they are now generally spread over the Province, the shores of the great Bay of Fundy will be their last haunt. The attractions of porpoise-hunting, the only chase left them, and the St. Francis Xavier reserve, the one settlement of Nova Scotia still in existence, will keep them lingering around the Digby Gut. Here they will lazily plant their barren fields, hunt porpoise, shoot gulls, and make woodenware and baskets, fading away, the victims of altered circumstances, as their congeners, the cariboo and the moose, have done before them.

It is evident that the time has long passed to consider them as a nation, in approaching them for their good. The sooner all national feeling, language and traditions are gone the better. They must be approached as individual men and women, taught English, to write, and to speak it. The English boot and trowsers have done much for them. A few years ago many most sincere persons gave large sums of money to civilize them. Their money and work were all wasted, if not injuring the race they sincerely sought to benefit.

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followed by such rapid actions, like the recoil of a steel spring, is what no white man may learn,—is hereditary. These powers remain in some individuals still, but the individuals are fewer. But few hunt, and of the Indians collectively, it may now be said they do not live by the chase. Basket making and woodenware, a little planting of potatoes, selling porpoise oil, sometimes moose-meat, and a few furs, with occasional hiring at stream driving, afford a miserable living to those who need only food and othing, paying neither rent nor taxes.

By a most fatal mistake in natural laws, and by teaching them their own language, by printing what were called (but really were not) Mic-Mac books and gospels, they meddled with their faith, and sought to carry them back to their old worn-out life and language, now sadly disjointed from the present times. Their only language should be English. They have no written character dating beyond their conversion to Christianity; but amongst them are devotional books in manuscript, hieroglyphics where a figure like a beaver stands for a sentence, and others, also manuscript, where the sounds appear to have been reduced to English letters somewhat modified, but all derived from the French clergy. We can only lament so much money, and so much hard work sincerely wasted, in harrassing their untutored minds with another language and another faith, before they had taught them to wear shoes and stockings, or to eat from tables.

In making a list of names and families, I have had recourse to ancient treaties, old vouchers and Government lists, and my own knowledge. I have found that many, and those the most permanent ones, are derived from Scripture, and were no doubt given them by the French clergy in baptism, others seem territorial, and others seem to have sprung from illicit intercourse with the whites, the son taking the white father's name. Many found in old records have died out. The Cape Breton names are peculiarly French, as it was held by the French fifty years after Nova Scotia. The families whose names are derived from original baptism by the French clergy, are :—

Peter,	Thaughmough,	Nicola,
Paul,	Bernard,	Juhairie,
Noel,	Glode,	Phillip,
Thomas,	Meuse,	Bettis,
Slome,	Leuxy,	Martin,
Toni,	Charles,	Joseph,
Jeremy,	Francois,	Cobadeel,
Scire,	John,	Simon,
Sosop,	Elixe,	Louis,
Malti,	Pattus,	Mick.
Toma,	Tonsux.	

Thus Noel means Xtmas ; Toma and Thaughmough comes from Thomas ; Slome from Siloom ; Toni from Anthony ; Sosop from Joseph ; Malti from Matthias ; Glode from Claude, by the follow-ng steps :—Clod, (1744) Cloud, Cloat, Gloat, Gleude, Glode, so spelt in old records to the present day. Meuse from Michael ; thus Moesel alias Michael is found in an old treaty, (1744), then Mosel, then Mioce, who held a brevet and medal from Duquesnol, French Governor of Cape Breton, though a British subject, living at La Have, (ob circa 1754), then Francis Mius, son of the same, dying at Clare, (1811), but holding brevet and medal, and according to the good Father Segoigne, not transmitting their high reputation in faith and morals. James Meuse, lineal descendant of the same, now holds the medal and still retains the Indian Governorship at St. Francis Xavier Settlement, Bear River. Thus in almost every instance we can refer the names in this list to their original baptism.

In the next list we find the white names indicating their various crossings ; but as the descendants of these half-breeds intermarry with whole breeds, the tendency is to return to the old race. The families whose names are derived from the whites, are :—

Williams,	Stevens,	Bartlet,
Knockwood,	Barron,	Bradford,
Nocot,	Mitchell,	M'Grode,
Nogood,	Wilmot,	Ball,
Nuffcoat,	Hadley,	Guy,
Morrice,	Wisdom,	Davis,
Knowland,	Duncan,	Alley,
Cope,	Walton,	Wise,
Coop,	Nugent,	Butmere.
Brooks,		

This list sufficiently shows its origin. Perhaps Nocot, Nogood, Nuffcoat, may all come from Knockwood, whilst Bradford now has a negro strain.

In the next, which finishes the list, are many we can scarcely class, and have become extinct.

Pictou,	Oakum,	Porpus,
Labrador,	Pulpis,	Brinaugh,
Mabou,	Petition,	Leguire,
Kalecl,	Bonta,	Savio,
Lapier,	Paspish,	Bardo,
Genesh,	Muscataway,	Snasin,
Penaul,	Amquasset,	Snake,
Letone,	Algomartin,	Mercatowan,
Morier,	Agamone,	Pearless,
Prospea,	Beatle,	Polalance,
Brospea,	Bobbii,	Sesough,
Brashea,	Marble,	Hogamaw,
Sheponie,	Quarrel,	Dinney,
Lurlau,	Docomorno,	Gogos.
Legou,		

In this list we find several that may be called territorial, as Mabou, Pictou, Labrador, Genish to be represented by one, Jackish, who surrendered to Governor Mascarene, (ob circa 1740); some with a French origin and many evidently, as Algomartink, Muscatawry, and others of remote Indian origin. These last all appear, some of them many times in old manuscripts, but are now, with a few exceptions, extinct.

The spelling has been made by the various writers of these old papers, seemingly each one by his own idea of sound, and thus families may have been confounded. In saying that at present there may be about forty to fifty-five families in the Province is an approximation.

To show the uncertainty of any deductions from these words of an unwritten dialect, we have a tradition of a great chief named Hogomaw, who fought against Wolf at Louisbourg and Quebec, and was there saved from being shot by having spared an officer at Louisbourg, and his grave is still shown in Cape Breton. Now Malti Pictou, an Indian of Digby County, upon hearing the word Hogomaw, said directly, "that means where big tree lies fallen." Thus memory and tradition having died out, even among his descendants, now named Dinneys, the beautiful epithet for a Red warrior's grave has passed into a name for himself.

To further illustrate the Indians, I will give a sketch of a visit to St. Francis Xavier settlement, Beaver River, the most successful of all the experiments to attach them to the soil, made in July, 1877. It was formed by the late Mr. Justice Wiswell, acting under government, who called to his assistance the Abbe Segoigne, a French clergyman of great devotion and simplicity of habit, in 1828. A reserve of one thousand acres was divided into thirty-acre lots, and one lot given to each head of family, upon certain conditions, and not on fee simple. At present about twenty-five families reside upon it, each in its own house. A road about a mile and a half long and fairly enclosed by stone dyke or rail fence runs through it. A few potato patches, pot herbs and garden bits about each house are the only signs of cultivation. All the fields were in hay lands or in pasturage. The houses were small frame ones, with glazed windows, shingled, and each with a porch. Inside they had good floors, chimney, cook-stove, table, but few chairs, and walls not plaistered, though some were papered with *Illustrated London News*. A porch and single room formed the lower floor, but there was an upper loft, approached by a ladder, which formed sleeping apartments.

In the whole settlement there was but one barn. Other fields were grown up by alders and birches, with Indian paths leading by devious routes to other houses,—to the chapel, or to the square lodge-like house, where had dwelt the Chief and his family for these fifty years. The chapel, a plain, square building, with porch and square windows, stands in an enclosure, guarded by many a rude grave with ruder head-stone, and quaintly carved wooden cross sticking through the coarse matted grass. These two buildings are by the charity of a descendant of Selina the famous Countess of Huntington, who was moved thereby by James Meuse, the Chief, visiting England about eighteen hundred and twenty-five. A print portrait of the lady still hangs upon the dingy walls. Though as an agricultural settlement, this is a failure, though each house stands bald, no barn or out-house standing by, with pig or chick or cow, as have the whites, and devious Indian paths lose themselves in open porches of houses passed in and out, rather than dwelt in. Yet it may be called a success. Here have twenty-six families been weaned from wigwams and bed on the ground, to permanent dwellings, dry floors, to separation of sleeping rooms, to cook-stoves, and to a sense of the necessity of all these wants.

At the time of our visit,—Summer,—the men were all away shooting porpoise on the Bay of Fundy, and nothing but women and children were left behind. A scanty crop of potatoes, and letting their fields for pasturage, with here and there a cow, is all that they gain, save fire-wood and a home from the land. The sale of baskets and woodenware, with that of porpoise oil, berries, some deer meat and wages gained in log cutting, make up the scanty hoard which clothes and feeds them. Begging is carried on everywhere and every place. As are the habits of the citizens of this the most permanent and populous settlement, such are those of their fellows, scattered in smaller parties in every county of the Province,—of those who dwell at Cape Breton, in larger settlements, and who linger in Dartmouth, from its neighborhood to the metropolis. Much has been done. Dry feet and a cook-stove fits man for moral reform far more than any but the thoughtful will allow; but in all that is to be done, they must be considered as individuals,—the past forgotten, the future aimed at. They must be taught in English,—to write, to read, and to forget their own language, with all its traditions; but which is only and never was but a dialect of a roving tribe, with an ever varying pronunciation of years and individuals.

Instead of distributing the conventional blankets and pipes,—things of the past,—the Dominion Government should use the same means, in improving their very rude way of trying out fish oil and of selling their oils well in the American market. They mentally oppose farm labour, but are ready and skilful mechanics. Basket work, woodenware, especially mast hoops, buckets and barrels, they naturally take to. Surely it is better, and greater results will follow in running with their inclinations, and giving greater facilities to them in these directions. But the question, who is to do this?

The government can give means, but not the man. Unfortunately, we have not their confidence, and the unhappy attempt of converting them from their ancient faith a few years since, ended in widening the breach. This mission belongs to the church that won them from paganism. The late Abbe Segoigne is an instance of what good may be done, and how honored he was by the highest authorities and gentlemen of his time ; and no doubt should there now arise a gentleman of his profession, who made these two thousand poor souls his special mission, teaching them the language, the habits and manners of our own life, and do it as we unhappily cannot, not disturbing their faith ; and if in this he devoted himself, his life, his talents and labour, the government would soon put every means in his power, and men of all parties would honour him,—the government ridding itself of a troublesome thing, and all willing patiently to wait till the Indian stood side by side us as equal man, before he was burdened with the discussion of civil and religious liberties.

Art. V.—Notes on the Cariboo. By Robert Morrow, Esq.

(*Read before the Institute, April 9th*, 1877.)

This paper is the consequence of the following quotation from the " Fauna Boreali-Americana " of Sir John Richardson, pages 250 and 251 :—Mr. Hutchins " mentions that the buck (Cariboo) has a peculiar bag or cist in the lower part of the neck, about the bigness of a crown-piece, and filled with fine flaxen hair, neatly coiled round to the thickness of an inch. There is an opening through the skin, near the head, leading to the cist, but Mr. Hutchins does not offer a conjecture as to its uses in the economy of the animal. Camper found a membranous cist in the Reindeer, above the thyroid cartilage, and opening into the larynx, but I have met with no account of a cist with a duct opening externally like that described by Mr. Hutchins, and unfortunately, I was not aware of his remarks until the means of ascertaining whether such a sac exists in the Barren Ground Cariboo were beyond my reach."

This account of cist and sac for the last four or five years has occasioned me much thought; having several times looked for the cist without success, but always forgetting the sac, and not being able to obtain any information on these points, it occurred to me last Fall that the only way left was to look for a Cariboo, and examine it myself, and the result of this examination, and dissections of others, male and female, made since, I will now place before you. But first, it is necessary that Camper's description and drawing of the "membranous sac" from a Reindeer, "four years old" should be placed before you.

Camper says*:—"As I did not yet know the Reindeer, and as the inaccurate dissection which Stenon had made of it in 1672, and of which Valentyn gives an account, did not furnish me with much information, I was obliged to proceed to the examination (date, June, 1771) with great caution. I had often observed with astonishment, in the bucks, that when these animals swallowed, all the larynx rose and fell in a peculiar manner, and seemed to indicate something singular in this part. I then removed with much care the skin of the neck, uncertain of what I might find there.

"The muscles having been raised in the same way upon the sides, as I have represented them, I found a membranous sac, of which the origin was placed between the os hyoides and the 'thyroid cartilage.'

"Then I discovered two muscles which take their origin from the lower part of the 'os hyoides' exactly where the base of the 'os graniform' and the cornua meet. These muscles were flat and thin at their beginning, but they widened in descending towards their junction with the sac, and certainly serve to raise and support it, as well as to expel the air at the will of the animal.

"After I had opened the œsophagus from behind, I found under the base of the epiglottis a large orifice which admitted my finger very easily. This orifice spread and formed a membranons canal

* Vol. I, Chapter VI, page 338, Paris 1803, where reference is made by letters to a plate.

which, passing between the two muscles, terminated in a species of membranous sac. Consequently, the air driven from the lungs through the cleft of the larynx fell by this aperture into the sac, and necessarily caused a considerable swelling."

On the 4th December, I succeeded in killing a large and old buck Cariboo, some measurements of which were as follows:—

Length from muzzle to back of horns	1 ft. 6 in.
Back of horns to insertion of the tail	5 ft. 4 in.
Length of tail, including hair	9 in.
Height at shoulder	4 ft. 6 in.
Length from lower lip to hair sac, and opening into the larynx	1 ft. 8 in.
Length of liver	1 ft. 2 in.
Depth of liver at widest part	7 in.
Length of heart	9 in.
Diameter of do	6 in.

Lungs very large } I had no means in the woods of weighing
Trachea do., do., } either heart or lungs.

At this time I had not seen the account quoted from Camper, and groping somewhat in the dark, my specimen is not so perfect as it might otherwise have been. Examining the throat of the animal, the cist of Mr. Hutchins, "with an opening through the skin," does not exist, but immediately under the skin there was a roundish sub-triangular cyst or valve of cellular membrane "of the bigness of a crown-piece," and on cutting through the cellular membrane this valve is found to be a closed sac, with a peculiar lining membrane, and closely packed with what may be called loose hairs of a flaxen colour in a considerable quantity of sebaceous matter; at the same time, however, the lining membrane is covered with hair of the same quality, apparently growing from, and rather lightly attached to the lining membrane. Camper, in the account of his dissection, just read, has described the valve, as if it were the sac, and his drawing, a copy of which is before you, gives only the valve, as may be seen by examining the larynx of the animal obtained by me, or more conveniently the drawing of it, kindly made for this occasion by Dr. Gilpin. The muscles which Camper describes as connecting the sac with the "os hyoides," and which he considers peculiar to this organ, in my specimen do not exist, but their representatives are probably the muscles found in the larynx of the young buck by Dr. Sommers, as will later appear. The valve is connected with the omo-hyoid muscles as they pass towards their insertion in the hyoid bone. The valve which Camper has evidently taken to be the sac, lies outside of the mucous sac, but is incorporated with its anterior walls ; the inner wall of the true sac surrounds and is attached to the larnyx, extending longitudinally from the hyoid bone to the base of the thyroid cartilage, but from the imperfect state of the specimen already referred to, I cannot say how much further it extended ; and until a more perfect one is obtained, can only call the whole an organ of voice. The slit or "orifice," as Camper calls it, exists as he has described, but it opens into the laryngeal sac which lies above the valve, that is next the larynx, as already shown.

The dimensions of the larynx, after having been some time in spirits, are as follows :—

Length of larynx from base of epiglottis to base of thyroid cartilage	5 in.
Circumference of do	11 in.
Inside diameter of larynx	2 in.

The age of the reindeer, which Camper dissected, he says was "four years," but "it had not attained all its growth ;" again he says, "if we admit that this reindeer had not attained its full growth," and still further, "I cannot determine anything respecting the length of the life of the reindeer, save that it ought to reach the age of sixteen years, because it takes four years to attain all its growth, although, however, the epiphyses continue even some time after." He seems by this to have been in doubt as to the age of the animal, or whether it was fully grown, and it is therefore possible that the sac was not perfectly developed. The muscles described by him, taken in connection with those found in the young buck, make this very probable. For further comparison we therefore require a buck somewhat younger than that from which the larynx shown to you was obtained.

Wishing to obtain a more perfect specimen of the larynx of an adult buck,—during the past winter I have made every exertion to obtain one but without success,—a small buck was sent to me from Cumberland, which was dissected on the 27th January by Dr. Sommers, Dr. Gilpin, and myself, some of its dimensions were, say of Buck Calf 8 months old:—

Length from tip of nose to tail	4 ft. 5 in.
do. of tail	5 in.
Tip of nose to centre of ears	1 ft. 1 in.
Height	about 3 ft.
Liver	11 x 5½ in.
Weight of liver	2 lb. 6 oz.
Heart, 6 x 6, somewhat flattened, weight	1 lb. 1 oz.
Weight of lungs only	1 lb. 6 oz.
Total weight of animal, including heart, liver, lungs and kidneys, skin, and all except entrails	83 lbs.

A female calf, and an adult doe certainly not less than 6 years old, were put at my disposal by Mr. T. J. Egan, and dissected February 19th. Of this calf the measurements were not made, but those of the doe were as follows:—

Length from end of nose to base of horns	1 ft. 1 in.
Length base of horns to line of rump	4 ft. 11 in.
Height at the shoulder	3 ft. 10 in.
Girth behind the shoulder	3 ft. 10 in.
Length of trachea to bifurcation	1 ft. 8 in.
Length of larynx	3½ in.
Diameter of larynx	2¼ in.
do. trachea	2 in.
do. at bifurcation	2 in.
Weight of lungs, including trachea	4¼ lbs.
Length of right lung	1 ft. 2 in.
Greatest breadth of right lung	8 in.
Length of left lung	1 ft, 1 in.

Greatest breadth of left lung.................... 7 in.

Right Lung.—3 lobes. Upper lobe deeply cleft, with a small lappet between it and the middle lobe. The upper and middle lobes were quite distinct. The lower lobe had a large lappet nearly as large as the middle lobe.

Left Lung.—2 lobes. Upper lobe deeply cleft, giving it the appearance of two lobes. The lower lobe was quite distinct from the upper.

Weight of the heart......................... 2½ lbs.
Length of the heart......................... 8 in.
Circumference of the heart....................1 ft. 2½ in.

Of these three Caribou, Dr. Sommers has given me his notes as follows :—

" The dissection of the young Caribou provided by you, for the purpose of determining the anatomical structure and relations of the laryngeal sac, described by Camper, as existing in the Reindeer, together with subsequent examinations of the same parts in a female calf and an adult doe are recorded below for your information.

" 1st. *Larynx, &c.* Body of the hyoid bone, horse shoe shaped, flattened laterally having an equal width from middle to the cornua, which have a narrow termination, the representatives of the corniculi in man being greatly developed ; they pass upwards and backwards, measuring each over four inches in length, articulating by cartilage with the upper border of the body near its median line, separated, however, by an interval of about one-fourth of an inch, each consists of three pieces with cartilaginous connections, the united whole having the shape of a diminished human clavicle, its acromial end being more curved and attached forward. The larynx measured in front 2¼ inches ; behind, from upper border of arytenoid to lower border of cricoid cartilages, 2½ inches in length—circumference external 6¼ inches ; internal diameter nearly 2 inches ; the inferior or true vocal cords and ventriculi laryngi appeared faintly marked, for though visible when the larynx was entire, they disappeared when the organ was laid open, its inner face presenting an even surface from thyroid cartilage to sacculi above.

"At the notch formed in the upper border of the thyroid cartilage, by the junction of its Alæ, is found a pit or depression forward of the mucous membrane which lines it. Viewed in position, it would be taken for an opening leading into the thyro-hyoid space, and seems large enough to admit an ordinary lead pencil; a probe introduced here found a very shallow depression scarcely one-fourth of an inch in depth; this appearance was obliterated when the walls of the organ were stretched apart after section, but returned when the parts were allowed to resume their usual relations to each other. It is therefore a slight hernia or depression forward of the respiratory mucous membrane into the thyro-hyoid space; the thyro-hyoid membrane which forms here, the outer wall of the respiratory passage, is thin and lax; when the point of the little finger is forced into the depression it produces a sacculus, the walls of which will consist of mucous membrane internally, and the thyro-hyoid membrane externally, it finds here also, opposite the depression and partly filling the space, a flattened rounded oblong body about the size of a small horse bean; dissecting the areolar tissue, covering it in front, this body is seen external to and resting upon the thyro-hyoid membrane, its upper border connected with the base of the epiglottis is provided with a thin fibrous coat, and when cut into, presents to the eye a coarse granular structure.

"Arising apparently from the base of the epiglottis on either side 'possibly continuous with the thyro-epiglottidean and aryteno-epiglottidean muscles,' are two bands of muscular fibres, they pass over this body on either side, being connected with it by fibrous adhesions; extending forwards, they unite at its upper border, forming a single muscular band, which becomes inserted into the upper and inner edge of the hyoid bone; these fibres have no analogues in man.

"A microscopic examination of the structure forming this body, shows it to consist mostly of fatty tissue, with a moderate proportion of granular cells, apparently epithelial.

"The examination of the organ in an adult female, and female fawn, presents essentially the same anatomical peculiarities as given above; but the pit at the laryngeal notch is deeper in the doe than in either of the young animals, it not being obliterated when the parts are stretched. The vocal cords and ventricles are also much more developed; but the body described above is absent from the doe, and very rudimentary in the female fawn.

"On a consideration of the facts recorded, we must conclude that the organ described in part by Camper is peculiar to the adult male caribou, the specimen in your possession standing in proof. My dissections given above show that the organ exists in the immature male in a rudimentary form; but having all the parts necessary to its full development, present, we must conclude, that such development will advance with its growth. In both adult and immature females it is still more rudimentary, as the body which forms the valve in the adult male was not present in the doe, and was evidently atrophying in the fawn (female)."

From the above description of the larynx of the young male, together with that which I have pointed out in the adult, it would appear that by some unaccountable oversight, Camper in his account has only described the valve, passing over without observation, the true sac; but he points out that the female reindeer is without the organ above described; and also that it is not present in the male fallow deer; and from the specimen now exhibited, you will also perceive that it is absent in the Virginia deer. In this specimen you will notice the almost bony hardness of the thyroid cartilage.

I need hardly point out to you that the measurements of the two adult animals show that they were very fine specimens; but I may draw your attention to the size of the hearts and lungs, as well as mention that the windpipe in all four was very large, and that Camper has noticed this to be the case in his reindeer.

Inside of the hock of the Caribou, you will observe that there is a patch of hair of a lighter color and somewhat longer than that which covers the skin in its immediate neighborhood, and that the skin under this patch is slightly thicker than that immediately round it. This spot is usually called a "gland," whether it is strictly so, I cannot say; but at all events it is caused by an enlargement of the hair follicles, has a very strong smell, which you will immediately notice, and in the Caribou is a scent "gland." The matter producing this scent is of an entirely different character from that contained in the tubes. It appears to be a highly volatile oil, and resists salt for a long time after the surrounding skin has been thoroughly saturated, and when dry collects on the outside of the skin in the form of very small yellow waxy scales, such as would be left by minute portions of varnish. Although I did not see the animal use this so called "gland," yet my Indian who hunted with me in December saw a doe Caribou use it in this way; when she had finished urinating (she squats in the act almost exactly like a sheep), she rubbed these "glands" together, leaving true scent behind her for a short distance. When "creeping" moose or Caribou, it has been often a subject of enquiry with me why it was that beside the smell of the fresh urine, there floated above it as it were, and for some distance in advance, the true scent of the animal; and for myself, I have very little doubt but that this is one way at least in which these "glands" are used, and in confirmation, it may be mentioned that the dogs at one time openly used for hunting moose, did not often take the scent of that animal from the snow over which it had just passed, but stood upon their hind legs and took it, as if it had been rubbed from the "glands," as described. This point is merely mentioned in the hope that some gentleman present may be able to throw some light upon it, or keep it in mind when an opportunity offers for observations confirmatory or otherwise.

If you will look a little further down, that is, nearer the hoof, on the skins now before you, you will perceive on each leg just on the outside of the hinder part of the skin at the hair parting, a second "gland;" it is, perhaps, more "typical," than developed. You will notice that it has no smell, nor had it while the animal was warm. Professor Baird (Mammals of North America, page 633, U. S., P. R. R. Exp. and Surveys General Report), in his diagnosis taken from Gray's "*Knowsley Menagerie*," says: "The external metatarsal gland is above the middle of the leg." For this gland our President, Mr. T. J. Egan, and I had vainly sought for some years, in answer to enquiries made by an American naturalist, the Honorable Judge Caton, of Ottawa, Ill.; and this is the first one we have ever seen, and my Indian, to whom I pointed it out, immediately after the buck was shot, told me that he had never before seen it. It may be taken as a mark of adult age, and will not probably be found on any Caribou under the age, perhaps, of six years. This gland was 4 inches above the inscrtion of the dew claws, and 10¾ inches below the centre of the hock "gland." You will also see it on the leg of the old doe, but not so perfectly marked, perhaps owing to the lighter colour of the hair which surrounds it,—the doe having been killed in February, the buck in December.

It may not be out of place to mention that the buck Caribou, as well as the moose, often voids its urine while on the march, as the ox may be seen to do.

The tubes in the feet of the Caribou are another point to which your attention is directed, and which first attracted the notice of Dr. Gilpin, from inquiries made respecting them by the American naturalist already named. Dr. Gilpin and others, including myself, thought that they were only to be found in the hind feet of this animal, and the discovery of them in the fore feet is due entirely to Dr. Sommers.

In Camper's description of the reindeer, made in 1771, (vol. I. page 347, Paris, 1803) he says, speaking of these tubes: "In addition to the peculiarities of the reindeer, of which I have just spoken, I have discovered besides something very singular in the hind feet of this animal; that is to say, a deep sheath between the skin at the place where the dew claws are united together, of the size of the barrel of a quill, running deeply as far as the point where these dew claws are articulated with the bone of the metatarsus. These tubes were filled internally with long hairs, and a yellow oleagenous matter proceeded from them, the odour of which was not very agreeable.

"I have not found these tubes in the forefeet. It was not possible for me to discover the use of them, inasmuch as the heat of the summer obliged me to remove the flesh quickly from the skeleton;" and a little further on he says that in the feet of a reindeer, sent him in 1777, he did not find the tube in the hind foot, but one very apparent in the fore foot; and in another, sent him in 1778, the tubes were in the hind feet, but none in the fore feet, "so that I am not able to determine anything very exactly on this subject."

In the skin of one of the hind legs of the old buck, just above the coronet, you will see the tube, the bones having been removed for the purpose. The tube of the other foot has been sacrificed to experiment; and among the other specimens in spirits, are the hind and fore foot of a young buck, and the hind foot of a Virginia deer; and of the latter, a separate tube, and also dried, the hind and fore foot of the old doe caribou, and fore foot of the young one, and skins from the fore feet of the old buck. In the skin of the fore feet of the old buck there is and was no appearance of the tubes, they have been absorbed. By many, it appears to me erroneously, these tubes are considered to be scent "glands." Camper evidently did not think so; but he says (page 348): "The skin of the fore feet, as well as that of the hind, which unite the dew claws, were sprinkled with thousands of glandules, which probably give out an oleagenous matter, intended to protect the hoofs against the snow." This, it appears to me, may be said as to the "glandules" of any part of the skin with equal correctness. Prior to December last, having paid very little attention to these tubes, and having superficially examined only a few specimens some days killed, had the question been asked me, were they scent glands, the answer might have been affirmative; but after a careful examination of the animal while warm, my original note made in the woods reads, "The passage or so-called 'gland,' opening in the front of the hind foot, terminates close to the skin of its under surface. It is hair lined to its extremity. The separation or unity of this tube with the lower part of the sole skin is by 'fascia' attached to the apex of the passage; it is not a gland properly so called." From further examination of a number of fresh tubes, and from the observations made by Dr. Sommers, my first view that they were for the purpose of strengthening the bones of the foot of this animal in its spring or jump, does not now appear to me to be tenable, and for my own part, I adopt Camper's statement, and cannot say what their use may be; but they are not scent glands, if they were, it appears scarcely probable that as the buck comes to maturity he would be deprived of the means of leaving scent from his fore feet at the time when he most requires it, without taking into consideration the fact that the tube only exists in the fore feet of the male (up to an unknown age), or in the female in a rudimentary state.

The tubes in the hind feet of the Caribou are filled with a waxy matter (those in the fore feet being only rudimentary, contain but very little), and so are the tubes, one in each foot, of the Virginia deer; but this is retained in them, owing to the shape. That of the Caribou is rather wider in its mouth and of more equal diameter to its lower end than that of the Virginia deer, which, at its opening, is somewhat constricted and widens towards its centre; and the tubes of these two animals retain this waxy matter or scales, while the moose which, contrary to preconceived ideas (and this shows how little we study our animals), also has the tubes in its feet, fully developed in the hind, rudimentary in the fore feet, and if you will look at the hind foot, kindly sent me by A. Chipman Smith, Esq., Mayor of St. John, you will see that the tube is of a very different shape from that of the other two animals, being in the hind feet, very wide at the mouth, and gradually narrowing towards its lower extremity; from its shape it can retain but little, if any, of this "waxy" matter, it being washed out by any swamp or by the grass or plants through which it would pass. The disagreeable smell ascribed to this matter is owing in a great measure to the quantity of it which is contained in a narrow space. In general terms it may be summed up that the Caribou buck when young has the tubes in the fore feet in a rudimentary form, which instead of passing upward and backward to the skin close to the dew claws, as in the developed tubes of the hind feet, lie between the hollow of, and nearly parallel with the bones of the feet, and that they are gradually absorbed until certainly in the adult male they entirely disappear. The doe has them also rudimentary in the fore feet;

perfectly developed in the hind, and it is a question which is yet to be decided whether the tubes ever entirely fade out of the feet of the doe. In the old doe, the age of which cannot be less than six years, although small, the tubes are still plainly to be seen.

A young moose, in possession of Mr. J. W. Stairs, has these tubes in all its feet. Those in the hind feet are fully developed, and pass in the same way as those of the Caribou,—between the phalanges; in the fore feet they are as in the Caribou of the same age, not passing upward and backward between the bones, but lying between and nearly parallel with them, and being, as in the Caribou, only rudimentary; but at what time of life they disappear in this animal, or whether in male or female, or both, cannot, owing to our prohibitory law, at present be decided.

The bones of the fore feet of the Caribou have the same general appearance as those of the moose. The "splint" bone is, however, very much shorter in proportion. In the hind feet the bones are the same; in the Caribou they are, however, rounder than in the moose.

Permit me to tax your patience a little longer, it has been shown that the Caribou and Moose have the tubes fully developed in the hind feet, and rudimentary in the fore. An examination of a Wapiti or Elk (Cervus Canadensis) skin with feet attached, in Mr. Egan's collection, presented the fact, confirmed by Judge Caton, that this animal has no tube in any foot, and that its feet are of a different shape from those of the Caribou, Moose, and Virginia Deer, being * broader and shorter, and that the length of the phalanges is very much less in proportion to the size of the animal in

* Professor Baird, U. S. P. R. R. Exp. and Surveys, page 638, Sp. ch.: "Hoofs short, broad and rounded;" 639: "The hoofs of the elk, fig. 10, are very different from those of the smaller deer; instead of being narrow and pointed, they are short, broad, and with the outer edge of the under surface much rounded; in fact, they bear a very close resemblance beneath, to those of a buffalo. . . . In the hind foot of the elk, the hoof is rather longer. . . . The length but little greater than the width of both hoofs together. The anterior hoofs are rather the largest.

"There is a patch of whitish hairs on the outer edge of the hind leg, about one-third the length of the metatarsus, from its upper edge. This is narrow and about two inches long. There is no naked space between these hairs, as in the Virginia deer. I have not observed the bushy bunch or patch of long hairs seen on the inside of the tarsal region in the Virginia deer, though it may possibly exist." (Judge Caton says it does not.)

the specimen referred to, than in the Caribou and Virginia Deer; from the metecarpo-phalangeal articulation, to the point of the hoof, they measure 7 inches; while those of the young buck Caribou, measured 7¼ inches, of the old doe 7½ inches, and of the old buck 9 inches. The gentleman already referred to, informs me that the Wapiti is a natural trotter, * "he, however, can, and does run much faster than he can trot, but it is a laboured effort, and soon tires him out." "His run is an awkward, lumbering, rolling gallop. A few hundred yards of this gait tells. It is said that an Elk will trot at an equal speed without stopping, or even flagging for twenty miles." The Virginia Deer has a tube scantily furnished interiorly with short hairs, fully developed in each foot, which led me to inquire respecting the gait of this animal, my impression being that it would prove to be a galloping or running deer, and this has been confirmed. "The natural gait of the Virginia Deer is a gallop or run. He never trots except when he wants to move a short distance voluntarily, and then it is a slow lazy gait."

The inference which you will allow me to draw from this is, that the number of tubes in the feet of the different species of deer will point out the gait of the animal, that is, those which have a fully developed tube in each foot, should be bounders and runners, while those wanting the tubes, or having them partially developed in the fore and fully in the hind feet should be trotters. The point is one which has not, to my knowledge, been touched upon by any naturalist; and as it cannot be further inquired into among us where we have only the Moose and Caribou, it is mentioned in the hope that it may be examined into by those who have access to a number of different species of Deer.

It remains for me to present to you the notes of the scientific examinations of the tubes, kindly furnished by Dr. Sommers, as follows:—

In the observations here annexed, I have endeavoured to furnish an accurate description of the so-called "interdigital glands" which exist in the feet of the Cariboo, by subjecting them to very careful anatomical and microscopical inspection. The conclusion at which

* "Plains of the Great West," by Col. Dodge, pages 164 and 166.

I arrive, relative to their structure and functions is, that they are not glandular, in the correct meaning of that term, an opinion which coincides with that which you previously expressed.

Caribou Buck, 8 Months Old—Hind Foot.

"The cleft in the hoof is very deep, and the phalanges are loose and movable, the only connection of any consequence existing between them being formed by the skin covering the hoof. It forms a broad web between the phalangeal bones, thus affording a broad surface with which the animal may rest upon the ground; the cleft in the hind foot measures from metecarpo-phalangeal articulation, to the tip of hoof, 7¼ inches. In the fore foot, it measured 7½ inches, the free border of the web in both feet is found at the insertion of the nails or hoofs into the skin, the length of web being about 5 inches, greatest width at free border 1½ inches, diminishing gradually upwards, the anterior and posterior walls of the web are separated by an interval filled with areolar tissue, and a small proportion of fat.

"About one and a-half inches above the edge of the web in its anterior wall, at a point midway and opposite to the articulation of the first and second sets of toe bones is found a circular opening or foramen, large enough to admit the barrel of a goose quill, it gives passage to a tuft of hairs lighter coloured than the surrounding ones, which are slightly smeared or stiffened with smegma, a probe introduced here discloses a passage or "cul de sac" continuous with this opening, having a depth of one and a quarter inches. On dissecting the skin from the under side or sole, and removing the surrounding tissue, the "cul de sac" was exposed, extending upwards and backwards between the proximal phalanges, approaching, but contracting no adhesion to the skin of the sole, and terminating at a point corresponding to the articulation of the dew claws with the splint.

"This organ presents the appearance of a fleshy tube with thick walls, and a rounded blind extremity like that of a small test tube, flattened on its posterior or under side, convex on its upper or anterior side, about one and a-half inches in length below, somewhat shorter above, its circumference being about three quarters of an inch: it tapers slightly towards its termination. When viewed in position, it bears a striking resemblance to the human uvula.

"The surface exposed by dissection exhibits a structure consisting of rounded or slightly polygonal spaces, resembling very large cells, these are convex of a deep red colour, and united by paler interspaces. The whole organ has the appearance of a body constituted of immense cells united by their thin cell walls. This, however is deceptive; these spaces are the rounded terminations or bases of the bulbs or follicles from which the hairs inside of the sac grow: the resemblance to cellular interspaces arises from the pressure of a very delicate layer of true skin upon which they rest, and which has been pushed into these interspaces by the growth of the hair follicles. The same structure can be observed in other parts of the skin by dissecting off the true skin which is underneath from the epithelial layer which covers it, and gives origin to the hairs, but here the spaces observed are much smaller, since the hairs and their bulbs are more crowded, the space occupied by each bulb being less than in the cul de sac, or organ under notice.

"On examining the web of the fore foot, the opening was found similar in character and co-relative position, to that of the hind foot; previous to making these dissections, I was informed that this structure did not exist in the fore feet of the Caribou, nevertheless certain preconceived opinions relative to its structure and function, led me to seek for it here. The organ in the fore feet differs from that in the hind, by being very shallow, measuring not over one-quarter of an inch in depth; this is due to the drawing up and partial obliteration of its anterior wall; when dissected from the surrounding tissue, it presents all the characteristics of the organ in the hind foot, yet it differs in its position relative to the phalangeal bones, for instead of passing obliquely between them as in the hind foot, it lies in the same plane as that of the anterior wall of the web, its own anterior wall being incorporated with the under surface of the skin, being thereby shortened to about one-quarter of an inch in length; the posterior wall, however, remains distinct and measures from the blind extremity to its termination in the skin, somewhat over an inch.

"The microscopic examination of this organ proved it to be of Epidermic origin. Sections through the thickness of its walls showed an external layer of flattened prismoidal cells with small nuclei, a deeper or internal layer in which the cells were more rounded and filled with granular protoplasm, (this difference in the uppermost and lowermost layer was brought out by the staining process, and it is in these only that we find the line of demarcation, the intervening layers merging gradually one into the other). Other structures observed were the hairs and hair follicles with their accompanying tissues, and some fibres representing, no doubt, the true skin, which is not developed in these organs to any considerable extent. The two layers of cells correspond to the same parts in man, viz., a horny layer external, but of course internal in the 'cul-de-scac;' a mucous layer external when the sac is dissected from its surroundings, the changed position of these layers is owing to the circumstance of the sac's being an invagination of the epidermic layer into the true skin.

"Regarding the function of this structure, various and contradictory opinions are expressed, that of its being glandular being most prevalent; again it is said to have no existence in the Wapiti and Moose, and fore feet of the adult Caribou. The fact of its existence in fore and hind feet of the Virginia Deer being well understood, its presence in this animal is said to be for the purpose of leaving a trace or scent on the ground, and in this way serving the union of the sexes at certain seasons, but if this is the case, we may ask why should it not exist in the Wapiti and be fully developed in the Caribou and Moose, since it must be obvious to us that the fulfilment of the conditions which obtain in the Virginia Deer are required also in the Wapiti; more than this, we know that a true scent organ in the Caribou is situated on the inside of the heels or gambrils.

"I may say here that on the occasion of my first dissection of the organ in the Caribou buck fawn, I expressed the opinion, that this organ or structure would be found also in the fore feet of the adult animal, though perhaps more rudimentary; a subsequent examination of the fore feet in an adult doe confirmed this opinion in the fullest degree, since I there found the structure as well developed as in the young animal. I now feel more than ever convinced that it exists in all our deer tribe, not excluding the Wapiti, although it may be larger in some than in others; an immature living moose in possession of Mr. J. W. Stairs, being provided with it.

"The following summary of its Histological relations will aid in arriving at correct conclusions relative to its importance:—

"1st. It is a growth or offset from the epidermic layer of the skin, invaginated between the phalangeal bones, containing the Malpighian and horny layers of the epidermis, and carrying with it a very thin layer of the true skin.

"2nd. Hair follicles and hairs growing from its internal walls and emerging through its opening, these being also epidermic or of epithelial origin.

"3rd. The absence of glandular tissue, excepting the sebaceous follicles which accompany the hair follicles or bulbs over the whole integument of the animal, 'this exception is made for obvious anatomical reasons,' nevertheless the sebaceous follicles were not observed in the specimens examined with the microscope.

"4th. The examination of the matter filling the tubes in the Virginia Deer, and present in much smaller proportion in the Caribou, showed it to consist in principal part of desquamated epidermic scales and oil globules; microscopically it resembled smegma from the skin of man, or perhaps closer still the 'vernix caseosa,' from that of the recently delivered infant, remembering that the epidermis in man and in all animals is a non-vascular tissue, that unlike our other tissues it is shelled off from the surface; we can readily account for these desquamated scales being retained here in a narrow pocket, from which they could not be readily discharged. Retrograde changes in these cells, secretions from sebaceous and sweat glands in adjacent parts will account, not only for the oily matter seen, the viscidity of the substance, but also for the odour which it possesses, the latter being no greater than that of the general integument, and arises from the same cause, viz.: the perspiration, but in this respect they are not in any degree comparable with the glandular collection at the hocks before mentioned, which will retain the peculiar odour of the animal for a long period after the removal of the skin.

"'In the presence of these facts we must conclude that this organ is only rudimentary, having no function which is obvious to us, it is not a secreting organ since it lacks glandular tissue; the opening in the dorsum instead of the sole of the foot would point also in this way; it does not serve to give strength or firmness to the foot, having none of the toughness and elasticity of skin in other parts, without comparison with the tendons, etc., which are provided for this purpose. Organs without uses are found from man downwards, we sometimes call them fœtal structures because some are well developed and are in use before birth, wither and remain useless after birth; for example, the woolfian bodies, said to be represented by the suprarenal capsules; others have no obvious use at any period, but are better developed in the fœtus than in the adult; example, Appendix vermiformis in man, others may point to structural affinities inherited from a distant period, of which natural history furnishes many examples.

"'From an individual point of view, taking in all the circumstances referred to, there appear to be only two ways of accounting for this structure, it is either an aborted ungual follicle or otherwise it is a 'cul-du-sac' representing the suture formed by coalescence of the skin from side to side in the fœtus. Its structure would convince one of the first conclusion, if the animal had rudimentary toe bones in the same position, indicative of a three toed ancestor, but all observations relative to the morphology of the foot, are opposed to this view, since the outer bones and their appendages are aborted in all animals of this kind. We are therefore compelled to adopt the other view which can be only settled saisfactorily by examination of the part in the fœtus. Nevertheless from knowing the difficulty of substantiating any theory connected with its supposed origin and use; still more of ridding one's mind of a theory once entertained, my faith in either of these is held very loosely."

In conclusion, it may be that what I have written has been better told by some one more competent to the task, but I have not met with anything upon the subject of the sac and tubes except in Camper's works. The notes of Dr. Sommers, which he kindly handed to me to be used as I saw fit, are given in full, as those which might have been made by me would only be the notes of a hunter, and therefore of but little value in comparison. I regret that I have been unable to explain more fully the use of the sac, but what additional light has been added may possibly encourage some other, naturalist or hunter, to continue the enquiry.

Art. VI.—Nova Scotian Meteorology. By F. Allison, Esq., M. A., *Chief Meteorological Agent.*

(*Read before the Institute*, 14*th May*, 1877.)

The facts, deductions, and opinions, brought before this Institute in this little paper, are the results of over fourteen years of personal observation at Halifax, of all elements entering into the constitution of climate; to which are added several previous years of observation of Temperature and Rain by the Medical Officers at the Citadel, which were taken under excellent supervision, and considered to be trustworthy enough for scientific calculation. I have also been much assisted by many careful observers through this Province, and in Prince Edward Island, and Newfoundland, to whom I would thus publicly tender my thanks; and some of whom are now performing good service in the Dominion Meteorological organization. Most of the following remarks, though taken directly at and for Halifax, are applicable to all Nova Scotia. The deviations from this general rule will be noted as we proceed.

Heat—its degree and alternations—must of course lie at the bottom of all considerations of climate; but for several reasons of convenience, the first instrument we record is the Barometer.

Let me again mention, that beside almost all Barometers having a considerable error in themselves, they are commonly observed by the public without regard to the marking of the attached Thermometers, or their height above the level of the sea. Obviously, their readings are constantly wrong, generally too low. It may be argued, that if the readings be always made from the same instrument, merely to test the condition of the atmosphere at the one point, and not for comparative or scientific purposes, they serve the end sought. But this is not correct, even with this small object alone in view, for the temperature will always affect the mercurial column; and as it cannot be kept regular to a degree, these simple readings must prove erroneous. Thus, let the observed height of the column be 29.750, and the attached Thermometer 70°, and again, let the same observed height remain, but with temperature reduced to 40°—which may easily happen in any room—and the ordinary observer says that the pressure is the same; whereas, if the first instance be only 29.750 in reality, the latter observation is .080 higher, or 29.830, else the Barometer could not retain its apparent height with 30° reduction of temperature. Therefore, when I speak of Barometrical Height, or Pressure of Atmosphere, I mean with all corrections included, viz., instrumental error corrected, temperature calculated at 32°, Fahrenheit freezing point, and addition made for height above sea. Aneroid Barometers are not used in Meteorology, as though very useful in measuring elevation, they are very apt to get out of order without the observer's knowledge, and their rate of error is uncertain, beside the metal scale being unduly affected by heat, and they cannot be set to a point to obviate the expansion and contraction. The mean Pressure for the whole year at Halifax is 29.779, and this is near enough to that of other parts of the Province for application to any climatological purpose. The Barometer here has risen to 30.992, and fallen to 28.455, but from 29.000 to 30.500 inches is the general range, and readings outside of these limits are very rare. Our Barometrical altitude is comparatively low for our Latitude, but the weight of atmosphere is affected, like the other Meteorological constituents, by our Peninsular position, and proximity to the great ocean. Thus the mean Barometer in 1875, at Halifax, in Latitude 44°.39′ N., was 0.151 inches lower than that at the inland station of Brockville in Ontario, in almost the very same Latitude—44°.34′, while at Esquimault, in British Columbia, as we again approach the ocean on the West, the Barometer comes down again nearer the Nova Scotia means, although that station is 2 degrees farther North than any point in Nova Scotia where the observations are recorded. This comparatively small Pressure helps our climate to produce agricultural results, belonging to a more southern latitude inland, shewing that the atmosphere is lighter, because warmer. The equability of this Pressure is also our safeguard against the violent storms, which to the South, the West, the North, and East of us, rage frequently, but seldom touch this Province, its extreme limits being the most exposed to their ravages. This again, is partly due to the level surface of Nova Scotia; and when we complain of the monotony of our low sea coast, and the want of abrupt hills through the country, we should remember the compensation gained by our comparative immunity from high winds and heavy rains. The warmer (and lighter) air over the Gulf Stream to the Southward, and the mild waters of the Bay of Fundy to the North and West, assist in keeping level our Barometers, and thus preserving the general regularity of our climate.

Before leaving this topic of whole pressure, I will allude briefly to a much neglected item in calculating the weight of the atmosphere. The pressure, or elastic force of vapour, must be eliminated from the total, before we can get what we really want,—the dry air to be weighed by itself. This vapour, with relative humidity, is calculated from tables carefully prepared from the reading of the wet bulb Thermometer, and the difference between it and the day or true temperature of air. There is but a very slight discrepancy between Glaisher's tables for this purpose and Guyot's, but the latter is preferred, and is computed from the third edition of Regnault's tensions, in which he has "modified the numerical values of some of the coefficients" of the formula adopted. The barometric height is supposed to be 29.700 inches. "Enter the tables with the difference of the two thermometers, and the temperature of the wet-bulb given by observation. In the column headed by the observed difference of the thermometers, and on the horizontal line headed by the observed temperature of the wet thermometer, are found the force of vapour and the relative humidity corresponding to these temperatures." Let the apparent height of the column, reduced to 32° and to sea-level, be 29.800 inches, the temperature of air 43°, and of the wet-bulb 40°,—the difference thus being 3°; then you will use the psychrometrical table as above, and subtract 0.208 as force of vapour, giving the result—

29.800 inches.
— 0.208 "

29.592 "

as pressure of dry air, and the relative humidity will be 75.0. But suppose the barometer, and the difference between dry and wet bulbs, to be still the same, but the wet to be fallen to 33°, then you will subtract only 0.149, giving—

29.800 inches.
— 0.149 "

29.651 "

as dry pressure, and a relative humidity of 70.5. This will readily explain how necessary it is to take into account the temperature and difference of the bulbs, when calculating climatological results from barometric observations. The difference is increased or diminished simply by evaporation, depending again upon the capability of the atmosphere to hold moisture. Even in the heaviest rains there is generally a degree or more of difference between the thermometers; but a fog is complete saturation, or 100 per cent. of relative humidity.

As Nova Scotia has a less pressure than corresponds to its latitude, so should it have a greater heat than its proper due; but the immense stretches of snow and ice prevent that during the longer portion of the year; and as these frozen regions of land and water lie from the north-west to the north-east of us, and exert their influence over us from November to June, we have less heat during that period than might otherwise be expected. The mean yearly temperature of Halifax is 42°.81; of Digby, 43°.50; of

Truro, 41°; of Sydney, 41°.50; and of Baddeck, 39°.90. The series are not quite long enough to strike so accurate a normal at these country stations as in this city; but I have selected some of the best, at widely distant localities, and the errors will, I think, prove in time to be not very important. At St. John, N.B., in 1875, (the latest finished year that I have) the mean temperature was 38°.3, against 40°.2 at Halifax; 38°.2 and 38°.3 at Charlottetown and Georgetown, P. E. I., respectively; and 39°.1, 38°.1 and 37°.5 at the stations of Harbor Grace, St. John's, and Channel, in Newfoundland, in order. It is interesting to watch how the mean temperatures of each month vary at some of the Nova Scotia stations. In January, Digby is the warmest and Truro coldest. In February again, Digby is highest, but Sydney falls as low as Truro. In March, Digby still remains highest and Sydney lowest. In April, Digby is passed by Wolfville, while Sydney is far behind. In May, Windsor is warmest and Baddeck coldest. In June, the inland station of Windsor is still hottest, and the sea-side Baddeck much the coldest; and in July the extremes are observed at the same stations. But in August, Halifax increases much in proportion, while Baddeck is still the lowest, remaining so in September, when Wolfville marks the highest. In October, the interior becomes much colder, and Halifax is the warmest, and Truro slightly colder than any. Sydney takes first place in November, with Truro still coldest, where the latter remains through December, in which month Digby is a little higher than any. Digby gives the highest mean and Baddeck the lowest of five Nova Scotia stations for the year; but Wolfville, in May, June and August, and Windsor, in the five months following July, are too defective for fair comparisons, otherwise, as warm inland stations, they might contest first place with Digby.

The winds, their direction and force, are very important in deciding climate and calculating its effects. First—As to direction, westwardly winds are much more prevalent in Nova Scotia than those from any other quarter, giving a resultant,—whether we estimate force in connection with direction, or merely count the years' average of daily means,—of a very few degrees N. of W. During

January, February, March and April, the average wind keeps well N. of W. In May, we get it nearly W. In June, still farther S., and again nearly W. S. W., in July. In August and September, we have prevalent W. S. W. winds, going up to near the Winter average in October and November, till in December the N. W. wind prevails. In the Eastern part of Nova Scotia, the wind is more frequently from the East than in these central and Western counties, and there is a comparatively greater tendency to draw from S. E., so that the average wind which is N. of W., taking the Province as a whole, is a little S. of W. in Cape Breton. Rather than a cause, this direction is an effect due to geographical position, and a less humid atmosphere than Europe in the same latitude; so we will pass on to wind force.

The faulty construction, bad exposure, and deficient readings, make many of the Auemometers at out-stations untrustworthy for series sufficiently long to calculate means with accuracy; but from what I have been able to learn so far, the velocities for the Province, when all can be satisfactorily reduced, will not differ to any very great extent from those observed at this Chief Station.

In Halifax the result of 14 years observation places the average velocity about 9 miles per hour, (strictly 9.36), varying from a dead calm up to 63 miles per hour. This latter wonderful velocity I noted in the great gale of Sunday morning, the 3rd of August, 1867, which blew down many fences and trees on the Peninsula, also unroofing several buildings and destroying chimnies, etc. Fortunately the wind which had been S.E. for two days previous, and returned to that point that same evening, had veered S. during the greatest height of the gale, so that the wharves and shipping were partially protected and the destruction there was not so great as in some lesser S.E. gales. But a fearful sea broke on Meagher's Beach. The nearest approach to this wind was on August 24th and 25th, 1873. This will be remembered as the disastrous Cape Breton storm. In Halifax and westward it did not reach the violence exhibited in the Eastern Counties, but it blew up to 60 miles midnight of 24th, and continued very heavy the morning of the 25th. Here the direction was N. and N.NE. with thunder, lightning, and over 2.5 inches of rain in 22 hours.

Taking up the wind average forces of the months we find January a trifle above the year's normal. February still a little higher. March getting up to the maximum of 11.35. April falls off very much, and May remains much the same as its predecessor. But June shews a mean still less. July and August are far the most quiet months, the former giving an average of only 4.86, the latter the minimum of 4.69. September returns to near the mean of June. October increases a little more, while November approaches very near to March. In these two months the general force of wind is much the greatest. December has an average about equal to January.

Our Peninsular position, equal Barometric distribution, and level surface of country, divert many violent gales from this Province, and we cannot be too thankful that, as one of the most quiet spots of North America, we thus enjoy the most favourable facilities for the production of the land crops peculiar to the Latitude, and safety on our sea coast, compared with other shores of the Atlantic. Even in a station so far inland as Toronto the mean velocity is very much the same as our own. 30 miles an hour is the minimum of a gale, and in 1876 there were 20 gales; in 1875, 19; in 1874, 18; in 1873, 17; in 1872, 26, and in 1871, 26; of these 126 gales, 103 took place between October and March, inclusive. It is very rare to reach 30 miles per hour in May, June, July, or August, though the two heaviest gales, as recorded above, occurred in this latter month. In total precipitation both the rain and the water obtained from snow when melted, are included. The dry snow is first measured on a platform, and has been found to give on an average one-tenth of its depth in water. Thus one inch of level dry snow gives .100 of water over the same superficial area. Occasional the equivalent of 1 inch of snow varies from .090 to .110 of water, but one-tenth is quite near enough for an average. In Great Britain 1 inch of snow rarely measures over .090 of water, as the flakes generally lie much more loosely, and occupy more space than here.

In looking at total precipitation by the month, although the same months in different years vary very much, a tolerably long series—say of 11 years—gives a fair idea of the most wet and dry periods of the year; and in the fourteen complete years from which I now can calculate, the Precipitation of Nova Scotia can be distributed with sufficient accuracy. January, October, and November give very nearly the same results—about 5.5 inches—and are closely followed by February with an average of 5.4. April, December, March and May give 4.8, 4.6, 4.5, and 4.2, respectively. The normal fall of September is 3.9, of August 3.5, of June 3.4, and July is decidedly the driest month, with 2.9. It will be at once noticed how comparatively dry our Summer is; and that, dividing the year into two equal periods, the six months from 30th September to 31st March, yield 30 inches out of the normal annual 53, leaving 23 only for the warmer months. Or, going farther, and taking the four Winter months of December, January, February, and March, we find twenty inches in them; twenty inches also in the four Spring and Autumn months of April, May, October, and November, and only about thirteen during the remaining third, June, July, August, and September. Of the whole yearly precipitation, about 44.5 inches fall as rain, and the melted snow measures about 8.5 inches more, being the product of seven feet fallen frozen. The above figures are most applicable to Halifax and the Atlantic coast, but the yearly amount does not differ materially from this on the Gulf or Bay Shores, or Inland. The differences by season in the interior are a slightly heavier rain fall in Summer, and a little greater snow depth in winter, balanced by not quite so much rain water in Spring and Autumn. I find that the years of most snow and rain make the soil of Nova Scotia most productive, and are most satisfactory to our farmers, provided that the hay-making and harvest seasons are not wet. There are good reasons for both of these conclusions. A thick layer of snow from the beginning of December to the end of March, prevents the frost from striking very deeply into the ground; the ammonia of the rain and melting snow, combining with the salts of the soil, enables it to nourish the coming roots and grass; and the continuance of good sledding facilitates, the hauling out of all kinds of wood. April is better dry till the Spring ploughing and planting are over, but then we can stand a large quantity of rain till the middle of June, for proverbially, "a wet May makes good hay." From that date, till August is half gone, much rain is not needed, but the after crop needs moisture then ; and through September frequent and copious showers do the pastures more good than they can do harm in other ways. On all accounts, we are better off for a large rain fall in October and November, and we usually are blessed by it. Thus the swamps are filled, and freeze earlier and harder for the Winter's work ; and the brooks and rivers running high suit another great branch of the country's industry—lumbering. Indeed the labours of the woodsman, and of the mills are benefitted by rain at all times in this Province where evaporation is so great from March to October.

Of the four oldest provinces of Canada, the total precipitation of Nova Scotia is decidedly the greatest, as is the rain fall. As yet, the observations in British Columbia, Manitoba, and Prince Edward Island, are not numerous enough to place their averages in proper order; but, for the sake of comparison, calling Nova Scotia 40, New Brunswick would be 35, Quebec 26, and Ontario 23. In the latter Province so little rain falls (except in the W. and S. W. district) that frequently the draughts are injurious; and in Toronto, the facts prove that their already limited supply is decreasing, which causes much apprehension. Our large precipitation would be troublesome, did it come in smaller quantities on many days ; but this is not so, and we enjoy the farther advantage of having a great number of fair days. Thus Toronto, with an average fall of only 35.5 inches, scores but 186 fair days, while Halifax, with 53 inches rain and melted snow, has still an average of 204 days completely dry. Again, to show how free this Province is is from the light drizzling rains common in many other parts of the north temperate zone : the average rain fall of the London district for 60 years is about 24.5 inches,—less than half of our total precipitation, while the number of wholly dry days is very much the same in any year.

'ER FOR 1876.

e Sea-level 122.5 feet.

ALLISON.

	.	September.	October.	November.	December.	YEAR–1876.
Mean Temper	.29	54.12	45.49	38.67	22.84	42.06
Difference fro	.89	–2.90	–2.56	+1.61	–2.68	–0.56
Maximum Te	.2	72.2	70.0	62.8	43.0	90.2
Minimum Te	.4	37.2	27.0	18.1	–1.0	–16.9
Monthly and	.8	35.0	43.0	44.7	44.0	107.1
Mean Maxim	.52	64.54	54.36	44.33	30.28	51.66
Mean Minimu	45	45.34	37.77	33.51	14.25	33.40
Highest Daily	.14	62.71	58.00	57.25	35.61	75.14
Lowest Daily	.34	50.10	34.38	23.29	3.12	–6.78
Mean Daily R	.07	19.20	16.59	10.82	16.03	18.26
Greatest Dail	.8	30.2	30.9	26.8	33.2	44.6
Mean Pressur	953	29.941	29.825	29.883	29.743	29.900
Difference fro	143	+.076	—.005	+.125	—.013	+.112
Maximum Pr	287	30.494	30.199	30.520	30.519	30.992
Minimum Pr	591	29.308	29.145	29.288	28.921	28.774
Monthly and	696	1.186	1.054	1.232	1.598	2.218
Highest Daily	243	30.423	30.100	30.439	30.290	30.698
Lowest Daily	587	29.491	29.385	29.344	29.182	29.165
Mean Pressur	80	.341	.256	.219	.114	.262
Mean Relativ	.7	81.4	80.1	87.5	85.8	82.79
Mean Amoun	56	5.05	5.47	7.84	5.34	6.09
Difference fro	86	—.52	.00	+1.21	—1.11	+.13
Prevalent Dir	W.	W.S.W.	W.N.W.	W.N.W.	N.W.	W.
Mean Velocity	79	8.47	8.49	10.85	12.75	9.20
Difference fro	05	+2 35	+1.55	+.45	+4.24	+1.26

GENERAL METEOROLOGICAL REGISTER FOR 1876.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea-level 122.5 feet.

OBSERVED BY FREDERICK ALLISON.

1876.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR–1876.
Mean Temperature	21.74	22.81	28.87	36.30	45.36	60.40	63.80	64.29	54.12	45.49	38.67	22.84	42.06
Difference from Normal (14 years)	–0 88	+0.17	+0.47	+1.11	–2.02	+1.62	+0.57	+0.89	–2.90	–2.56	+1.61	–2.68	–0.56
Maximum Temperature	48.6	48.0	51.0	56.6	70.0	84.8	86.7	90.2	72.2	70.0	62.8	43.0	90.2
Minimum Temperature	–8.8	–16.9	7.1	19.6	29.9	36.2	49.2	46.4	37.2	27.0	18.1	–1.0	–16.9
Monthly and Annual Ranges	57.4	64.9	43.9	37.0	41.1	48.6	37.5	43.8	35.0	43.0	44.7	44.0	107.1
Mean Maximum Temperature	31.10	33.15	36.93	45.06	55.76	71.92	74.99	77.52	64.54	54.36	44.33	30.28	51.66
Mean Minimum Temperature	10.33	11.53	20.85	29.08	36.42	51.64	55.64	54 45	45.34	37.77	33.51	14.25	33.40
Highest Daily Mean Temperature	40.21	38.48	40.52	42.20	56.52	72.51	71.72	75.14	62.71	58.00	57.25	35.61	75.14
Lowest Daily Mean Temperature	7.51	–6.78	13.30	28.36	35.38	50.05	56.70	53.34	50.10	34.38	23.29	3.12	–6.78
Mean Daily Range of Temperature	20.77	21.62	16.08	15.98	19.34	20.28	19.35	23.07	19.20	16.59	10.82	16.03	18.26
Greatest Daily Range of Temperature	38.6	44.6	26.8	26.5	35.0	37.2	33.8	30.8	30.2	30.9	26.8	33.2	44.6
Mean Pressure Corrected	29.940	29.921	29.898	29.850	29.940	29.995	29.913	29.953	29.941	29.825	29.883	29.743	29.900
Difference from Normal (14 years)	+.160	+.145	+.095	+.107	+.200	+.208	+.123	+.143	+.076	—.005	+.125	—.013	+.112
Maximum Pressure	30.614	80.992	30.484	30.337	30.434	30.343	30.164	30.287	30.494	30.199	30.520	30.519	30.992
Minimum Pressure	29.063	28.774	28.981	29.342	29.219	29.484	29.433	29.591	29.308	29.145	29.288	28.921	28.774
Monthly and Annual Ranges	1.551	2.218	1.503	0.995	1.215	0.859	0.731	0.696	1 186	1.054	1.232	1.598	2.218
Highest Daily Mean Pressure	30.513	30.698	30.404	30.305	30.362	30.315	30.136	30.243	30.423	30.100	30.439	30.290	30.698
Lowest Daily Mean Pressure	29.304	29.165	29.242	29.434	29.346	29.527	29.649	29.687	29.491	29.385	29 344	29.182	29.165
Mean Pressure of Vapour	.112	.112	.138	.176	.243	.462	.488	.480	.341	.256	.219	.114	.262
Mean Relative Humidity	82.9	80.8	83.2	82.0	80.5	87.3	83.3	78.7	81.4	80.1	87.5	85.8	82.79
Mean Amount of Cloud	5.91	5.69	6.83	6.85	6.52	7.42	6.48	3.66	5.05	5.47	7.84	5.34	6.09
Difference from Normal (10 years)	—.32	+.24	+1.01	+.54	—.69	+1.33	+.73	—1.86	—.52	.00	+1.21	—1.11	+.13
Prevalent Direction of Wind	N.W.	N.W.	W.	W.	W.S.W.	S.S.W.	W.S.W.	W.S.W.	W.S.W.	W.N.W.	W.N.W.	N.W.	W.
Mean Velocity of Wind	9.97	11.47	11.35	9.39	8.66	6.07	6.17	6.79	8.47	8.49	10.85	12.75	9.20
Difference from Normal (14 years)	+1.04	+2.21	+1.10	+1.33	+.04	+.45	+1.22	+1.95	+2 35	+1.55	+.45	+4.24	+1.26
Amount of Rain	1.341	3.133	5.774	2.130	4.574	3.384	3.914	1.909	6.094	4.067	7.397	0.618	44.335
Difference from Normal (14 years)	+1.030	+0.077	+2.600	—0.719	+0.475	—0.097	+0.956	—1.618	+2.201	—1.393	+2.386	—2.431	+0.899
Number of Days Rain	.7	7	9	15	19	21	17	8	10	13	12	5	143
Difference from Normal (14 years)	.0	+1	+4	+5	+4	+6	+6	+3	0	0	0	—4	+17
Amount of Snow	21.10	33.23	5.60	9.95	0.90	0	0	0	0	0.01	inap.	25.58	96.37
Difference from Normal (14 years)	+2.05	+14.47	—10.63	+1.05	+0.28	0	0	0	0	—0.45	—3.88	+8.91	+13.10
Number of Days Snow	13	16	9	6	1	0	0	0	0	1	0	12	58
Difference from Normal (14 years)	+3	+7	—2	0	0	0	0	0	0	—1	—4	+1	+9
Total Precipitation	3.576	6 401	6.329	3.208	4.662	3.384	3.914	1.909	6.094	4.076	7.397	3.164	54.114
Difference from Normal (14 years)	—1.798	+0.984	+1.843	—1.354	+0.556	—0.097	+0.956	—1.618	+2.201	+1.385	+1.956	—1.385	+1.803
Number of Dry Days	13	13	13	10	12	9	14	23	20	17	18	17	179
Difference from Normal (14 years)	+4	—3	—5	—6	—4	—6	—6	+3	0	—2	+3	+3	—22
Number of Auroras	0	2	0	3	0	0	1	1	1	0	1	0	9
" Gales	3	4	4	1	0	0	0	0	0	1	2	6	21
" Fogs	4	0	7	3	10	18	14	2	2	4	1	1	66
" Dews	0	0	0	0	4	10	10	13	11	9	1	0	58
" Hoar Frosts	9	5	6	7	4	0	0	0	0	7	3	9	50
" Thunders	0	0	0	0	1	4	3	3	0	1	1	0	13
" Lightnings	0	0	1	2	2	5	1	6	0	1	1	1	20
" Hails	0	0	0	0	0	0	0	0	0	0	0	0	0
" Rainbows	0	0	0	0	0	4	0	2	1	1	0	0	8
" Lunar Halos	3	2	1	3	1	0	0	1	1	0	3	0	15
" Lunar Coronæ	0	0	0	1	0	0	1	0	0	0	3	1	6
" Solar Halos	0	0	5	2	1	3	0	0	0	1	0	0	12
" Days Sleighing	16	27	9	2	0	0	0	0	0	0	0	23	77

With this comparison I must conclude this paper, already extended beyond my first intention; but, with permission of the Institute, I hope on some future evening to complete these climatic remarks, by noticing the occasional phenomena and periodic events, which, with their causes and effects, contribute largely to our meteorological knowledge, and the probable and possible productions of our country.

Art. VII.—Geology of the Site of the Belleveau Mining Operations.—By Rev. John Burwash, M. A., Communicated by John T. Mellish, M. A.

(*Read May*, 1877.)

I.—Character of the Rocks.

The following paper is compiled from notes of observations made during a visit to the property of the Belleveau Albertite and Oil Company, in July, 1876. I may be allowed to state that my stay was short, and that my opportunity for personal observation was limited; but through the kind attention of Mr. Patrick, the Manager of the Mine, who conducted me to the principal exposures, and gave me the benefit of his knowledge of the locality which he has thoroughly studied, I was able to make a much better use of my time, and to obtain a much better knowledge of these rocks than would otherwise have been possible. I found Mr. Patrick practically well acquainted with the stratigraphy of the Carboniferous series in Nova Scotia, and his opinion of the position and relations of these beds, is well worthy of attention.

The place where the Company have sunk their shaft is situated in the Parish of Dorchester, between Memramcook and Peticodiac Rivers, about a mile from the latter, and about five and one-half miles in a direct line from the Albert Mine. It is, Mr. Patrick informed me, on the same line of upheaval as the latter; that is, taking the general direction of the strike at the Albert Mine, you would come to the Belleveau property.

There are two principal kinds of rock—shales and conglomerates. The shales are very characteristic of all places where veins of Albertite occur, and are described in Dr. Dawson's account of the geology of Albert Mine, under the name of Albert Shales. They can be traced all the way from Albert Mine to Belleveau. They, nearly all, contain Carbonate of Lime; some beds having crystals of calcite disseminated through them. They are bituminous, and it is a matter worthy of investigation, whether some of the beds could not be advantageously used for the production of oil or gas. As these shales are supposed to be the origin of the mineral, Albertite, the amount of their development and their bituminous character are matters of great importance to the miner in prospecting for this mineral.

The conglomerates are in massive beds, forming on account of their weathering more slowly than the softer shales, the summits of the ridges between which the shales form the depressions. They are grey, greenish grey and reddish grey rocks; some quite coarse, others passing into a gritty grey sandstone. One of the lowest beds of this rock deserves special mention. It has been named by Mr. Patrick "oil rock." It is a grey, micaceous sandstone, thoroughly saturated with, and having the characteristic odor of petroleum. It occurs, as Mr. Patrick informed me at the Albert Mine, and crops out in several places between that and Belleveau. On digging through this rock considerable quantities of petroleum flowed into the pit; and Mr. Patrick thinks that this is the source of nearly all the oil which has been found in this region. It is his opinion that oil might be obtained in paying quantities by boring where a considerable thickness of this rock is found near the surface; a condition which exists in the northern part of the Company's claims.

2.—Order of Strata.

The relative position of these shales and conglomerates is a somewhat difficult matter to determine. The spot selected for mining at Belleveau has the appearance of a centre of disturbance. The character of the beds would suggest the idea that some explosive force, confined within the earth, had there found vent. This disturbance and contortion of the Strata is especially seen on the Southern half of the claim. Here, Mr. Patrick thinks there is a great fault, the direction of which is 73° E. Along the line of this fault the shales are thrown up against the conglomerates, dipping from them at a high angle. This being the case, his opinion that the conglomerates overlie the shales, is probably correct, and goes with the description of their relations elsewhere, as given by Dr. Dawson. The strata of the conglomerates are nearly horizontal, while those of the shales dip southward at a high angle.

At a short distance north of the line of fault, there is a noteworthy outcrop, which seems to be the summit of an arch; the beds on the north being similar, in inverted order to those on the south. At this point, the shales are very much contorted, being corrugated as if by a combination of upward and lateral pressure. As an example, illustrating the forces at work in producing this formation, I obtained a piece of shale 15 inches in length, bent into the form of a double hook, or letter S., and having that peculiar "slickensided" appearance indicative of great pressure. This arch has its parallel in the arched strata near the Albert Mine, which are similarly contorted, and contain, like these, remains of fish of the general Palæoniscus. In fact, the general resemblance between the arrangement and conformation of the strata at Belleveau and Albert Mine is somewhat remarkable, especially when we take into account their disturbed condition. This resemblance is such as to justify the remark of Mr. Patrick that a section might be made of one, which would, with very little alteration, represent the other. North of this arch, in the bank of a small brook, there is exposed a considerable thickness of shale. Reckoning from this point to the arch, it would appear that these shales which are generally regarded as the source of the Albertite, are as fully developed here as at Albert Mine.

With respect to the question of the probable occurrence of any considerable quantity of Albertite in this locality, as the matter will shortly be practically tested, speculation is out of place.

Should the mining operations now in progress be successful, an impetus will be given to those researches which alone can develope the mineral wealth of our country; and in the case of Albertite prospecting, with largely increased chances of success.

ART. VIII.—ADDITIONS TO THE LIST OF NOVA SCOTIAN PLANTS. BY HENRY HOW, *D. C. L., Professor of Chemistry and Natural History, King's College, Windsor, N. S.*

THE following notes are intended to supplement the "Catalogue of the Flora of Nova Scotia" in the Proceedings and Transactions of the Nova Scotia Institute, 1875–76, by Dr. A. W. H. Lindsay, to whom botanists are much indebted for the first labour of its kind. The names of plants and stations below are either not given in the "Catalogue," or not on the responsibility now advanced. Some of the plants have been known to me as Nova Scotian as long as others in the Herbarium of my formation referred to by Dr. Lindsay, but not being represented in that collection, nor named in some short notes of mine published in the Transactions of the Nova Scotia Institute, 1871–72, of course are not placed in the "Catalogue" on my authority. The majority have been, however, I think, found since that Herbarium left my hands, (1876), either by myself or others, to whom credit is given, and some have been met with quite recently. In a few cases I have added a word or two, relating to local or Indian names, and other points, which may be found acceptable. I have also corrected a few errors.

For some particulars, I am indebted to Mr. G. A. Thompson, of Massachusetts. This gentleman came here chiefly for minerals, in 1873, having been directed to me. He was kind enough to give me a few botanical notes in return for showing him specimens, and advising him as to localities of minerals. The following observations of his will be found interesting.

"I was quite surprised to see the *Liriodendron tulipifera* successfully cultivated so far North. I had only seen one or two specimens in Massachusetts. The *Monotropa uniflora*, found at Scot's Bay, is somewhat rare near Boston, I think; at least, I have not seen it. Among other Heaths (Gray) I noticed that there seemed to be a total absence of *Gaultheria procumbens*, so common with us in Woburn, at Scot's Bay; it seems to be supplanted by the *Chiogenes*. I did not notice the *Kalmia latifolia, Azalea viscosa, A. nudiflora*, and *Rhodora Canadensis*, all of which are very common Heathworts with us in Woburn or Amherst, Mass. *Mitchella repens* was far less abundant than *Cornus Canadensis*, just as the reverse is true with us in Woburn. *Juglans Carya*, *Quercus*, and *Castenea*, sparingly represented. *Fagus* very common; *Abies* also, and *Larix*. *Juniperus Virginiana* not found at all. *J. communis* by no means abundant. Of course, the above notes are very imperfect, and are confined mainly to Scot's Bay, where I was obliged to pass through more or less woodland, etc., on my way to the shores of the Bay of Fundy."

The list of plants is made out to correspond with Dr. Lindsay's "catalogue":—

RANUNCULACEÆ.	
Clematis Virginiana, L.	n. N. Glasgow, Pictou.
Hepatica triloba, Chaix.	Nesbit's Island, Windsor, Hants.
Thalictrum Cornuti, L.	Digby Gut, Digby. (7 ft. high; 8 ft. at Windsor Falls.)
Ranunculus cymbalaria, Pursh.	Falmouth, Hants.
R. repens, L.	Windsor, "
R. acris, L.	Windsor, "
MAGNOLIACEÆ.	
Liriodendron tulipifera, L.	Waverley House, Canning, King's, ("a small tree, cultivated,") E. A. Thompson.
BERBERIDACEÆ.	
Berberis Vulgaris, L.	Windsor, Hants, (cultivated.)
NYMPHÆACEÆ.	
Nuphar advena, Ait.	Windsor, Hants.
PAPAVERACEÆ.	
Papaver somniferum, L.	Windsor, Hants, (introduced.)
FUMARIACEÆ.	
Corydalis glauca, Willd.	St. Croix, Hants.
CRUCIFERÆ.	
Cakile Americana, Nutt.	Halifax Harbour.
DROSERACEÆ.	
Drosera rotundifolia, L.	Scots' Bay, Kings; E. A. Thompson.
CARYOPHYLLACEÆ.	
Saponaria officinalis, L.	Windsor, Hants, (escaped.)
Lychnis githago, Lam.	New Glasgow, Pictou, (introd.)

Honkenya peploides, D. C.	Halifax Harbour.
Cerastium viscosum, L.	Windsor, Hants.
Sagina procumbens, L.	Windsor, Hants.
Spergularia rubra, Pers. Var. Marina.	Windsor, Hants; Halifax Harbour.
TILIACEÆ.	
Tilia Europæa.	Windsor, Hants, (planted.)
GERANIACEÆ.	
Oxalis acetosella, L.	Windsor, Hants; H.; Scots' Bay, Kings; E. A. Thompson.
Geranium Carolinianum, L.	Windsor, Hants; Rev. J. B. Uniacke.
G. Robertianum, L.	Spencer's Isl., Cum.; Marble Mt., C.B.
Impatiens fulva, L.	n. Digby, Moose River, Digby,
VITACEÆ.	
Ampelopsis quinquefolia.	Windsor, Hants, (cultivated.)
CELASTRACEÆ.	
Enonymus Americanus, L.	Windsor, Hants, (cultivated.)
STAPHYLEACEÆ.	
Staphylea primata.	Windsor, Hants, (cultivated.)
SAPINDACEÆ.	
A. Esculus Hippocastanum, L.	Windsor, Hants, (planted.)
Acer. pseudo-platanus, L.	Canning, King's; E. A. Thompson; (cultivated—"fine tree.")
LEGUMINOSEÆ.	
Vicia tetraspermum, L.	*not* Windsor, Hants, *as in* "*Catalogue.*"
V. cracca, L.	Granville, Annap.; E. A. Thompson.
Lathyrus maritimus, Bigelow.	Parrsboro', Cumb.; Long Isl., C. B.; Halifax Harbour.
Apios tuberosa.	Windsor, Hants, (brought from Little Harbour, Pictou; Indian name is Sagaban.)
ROSACEÆ.	
Cratægus oxyacantha, L.	Windsor, Hants.
Amelanchier Canadensis, Var. Botryapium, Gray.	Windsor, Hants. (Indian Pear, Mulberry.)
Dalibarda repens, L.	Bloomfield, Digby.
Rosa lucida, Ehrhart.	Windsor, Hants.
R. Carolina.	*not* Windsor, Hants, *as in* "*Cat.*"
ONAGRACEÆ.	
Epilobium angustifolium, L.	Pictou; Colchester.

CRASSULACEÆ.	
Sedum rhodiola, D. C.	n. Margaretville, Annap.? (intr.)
HAMAMELACEÆ.	
Hamamelis Virginica, L.	n. Windsor; Chester Road; Windsor Falls; Windsor, Hants.
UMBELLIFERÆ.	
Heracleum lanatum, Michx.	Marble Mt., C. B.
Conium maculatum, L.	Chester, Lunenburg.?
CORNACEÆ.	
Cornus Canadensis, L.	Scots' Bay, Kings; E. A. Thompson.
C. alternifolia, L.	Mt. Uniacke, Hants, (Herb. J. B. U.)
CAPRIFOLIACEÆ.	
Symphoricarpus racemosus, Michx.	Windsor, (cultivated.)
Sambucus pubens, Michx.	N. Mt., Annapolis. "White Elder," "Poison Elder."
Viburnum nudum, L.	Kentville, King's.
Lonicera periclymenum.	Granville, Annapolis; E. A. T.
RUBIACEÆ.	
Galium trifidum, L. Var. Tinctorium.	Marble Mt., C. B.
Mitchella ripens, L.	Scots' Bay, King's; E. A. T.
Houstonia cærulea, L.	Windsor, Hants; Horton Bluff, King's, Halifax Common.
COMPOSITÆ.	
Eupatorium perfoliatum, L.	Mt. Uniacke, Hants; Gates' Mt'n., Annapolis.
Tussilago farfara, L.	Horton Bluff, King's.
Tanacetum vulgare, L.	Windsor.
Graphalium polycephalum, Michx.	Coldbrook, King's.
Ambrosia artemisiæfolia, L.	Kentville, King's.
Achillea millefolium, L.	Wilmot, Annapolis (rose-colour.)
Lappa major, Gærtn.	Windsor.
Taraxacum Dens-leonis, Derf.	Windsor.
Sonchus arvensis.	Halifax Harbour.
CAMPANULACEÆ.	
Campanula rotundifolia, L.	D. Gut, Gulliver's Hole, Digby.
ERICACEÆ.	
Gaylussacia resinosa, Torr. & Gr.	Gold R., Chester, Lunenburg; General's Bridge, Annapolis.
Vaccinium macrocarpon, Ait.	Falmouth, Hants; Dr. Harding.

Chiogenes hispidula, Torr. & Gr.	Digby Neck, H.; Hantsport, Hants; Scots' Bay, King's; E. A. T.
Arctostaphylos Uva-ursi, Spreng.	Wilmot, Annapolis; G. Robertson.
Cassandra calyculata, Don.	Mt. Uniacke; Rev. J. B. Uniacke.
Andromeda polifolia, L.	do. do.
Moneses uniflora.	Scots' Bay, Kings; E. A. T.
Chimaphila umbellata.	Pembroke, Hants.
Monotropa uniflora, L.	n. Digby.
M. Hypopitys, L.	College Woods, Windsor, Hants, (under *spruce*, *not pine*.)
Ilex glabra, Gray.	N. W. Arm, Halifax; Capt. Hardy.
PLANTAGINACEÆ.	
Plantago major, L.	Windsor.
P. lanceolata, L.	Windsor.
PLUMBAGINACEÆ:	
Staticé Limonium, L.	Racket, Digby; Hantsport, Hants.
PRIMULACEÆ.	
Anagallis arvensis, L.	Granville, Annapolis; E. A. T.
SCROPHULARIACEÆ.	
Veronica scutellata, L.	Wilmot, Annapolis, (*not* Windsor, *as in* "*Cat.*")
Gerardia purpurea, L.	Gulliver's Hole, Sea Wall, etc., Digby.
Euphrasia officinalis, L.	Scots' Bay, King's; E. A. T.
Rhinanthus crista-galli, L.	Windsor, Falmouth, Hants; H. Granville, Annapolis; E. A. T.
VERBENACEÆ.	
Verbena hastata, L.	Nictaux Mines, Annapolis.
LABIATEÆ.	
Monarda didyma, L.	Windsor, (cultivated.)
Nepeta Cataria, L.	Windsor, (cultivated.)
N. Glechoma, Benth.	Windsor, (escaped.)
Galeopsis Tetrahit, L.	Scots' Bay, Kings; E. A. T.
Leonurus cardiaca, L.	Windsor.
Calamintha clinopodium, Benth.	St. Croix, Hants. ?
BORRAGINACEÆ.	
Mertensia maritima, Don.	Beach, Gulliver's Hole, Digby.
CONVOLVULACEÆ.	
Convolvulus arvensis, L.	Windsor.
Calystegia sepurm, R. Bronn.	Windsor, (H.); Canning, King's; E. A. T.

SOLANACEÆ.	
Nicandra physaloides, Gœrtn.	Windsor, (escaped.)
Datura Stramonium, L.	Windsor, (escaped.)
GENTIANACEÆ.	
Limnanthemum lacunosum, Griseb.	Lakes between Windsor and Halifax; Rev. J. B. Uniacke.
OLEACEÆ.	
Ligustrum Vulgare, L.	Windsor, (planted.)
CHENOPODIACEÆ.	
Chenopodium album, L.	Windsor.
Suæda maritima, Dumortier.	Windsor.
POLYGONACEÆ.	
Polygonum arifolium, L.	Windsor Road, 15 miles from Halifax.
P. cilinode, Michx.	N. Mt., Granville, Annap.; E. A. T.
Rumex crispus, L.	Windsor.
EUPHORBIACEÆ.	
Euphorbia nelioscopia, L.	Windsor.
E. cyparissias.	Windsor, (escaped.)
CUPULIFERÆ.	
Fagus ferruginea, Ait.	Marble Mt., C. B.
Corylus Americana, Walt.	Ponhook Lake, Windsor; E. Mt'n., Onslow, Col.
Ostrya Virginica.	Hantsport, Hants; E. A. T.
CONIFERÆ.	
Pinus strobus, L.	Windsor.
Abies balsamea, Marshall.	Windsor.
A. nigra, Poir.	Windsor, ("back in the woods.")
A. alba, Michx.	Windsor, ("the common spruce.")
A. Canadensis, Michx.	Windsor.
Larix Americana, Michx.	Windsor, H.; Scots' Bay; E. A. T.
Thuja occidentalis, L.	Windsor, (planted, does not flourish.)
Juniperus communis, L.	Mt. Uniacke, Hants; Part. Isl., Cum.; H.; Scots' Bay, King's; E. A. T.
TYPHACEÆ.	
Typha lalifolia, L.	Windsor.
NAIADACEÆ.	
Potamogeton lucens, L. Var. rufescens, Schreber.	Windsor Junction. ?
P heterophyllus, Schreber.	Welsford, Halifax. ?

ORCHIDACEÆ.	
Habenaria obtusata, Richardson.	Pine Tree, Merigomish. ?
Spiranthes cernua, Richard.	Wilmot, Annap.; Stillwater, Hants. ?
Arethusa bulbosa, L.	Mt. Uniacke, Hants; Rev. J. B. U.
Calopogon pulchellus, R. Brown.	3 miles from Springville, Cumb.; H. H. Jan.
Microstylis ophioglossoides, Nutt.	Ponhook Road, Windsor. ?
Cypripedium arietinum, R. Brown.	Newport; Rev. J. B. Uniacke.
IRIDACEÆ.	
Iris versicolor, L.	Windsor.
SMILACEÆ.	
Trillium cernuum, L.	Windsor; Rev. A. F. Hiltz.
LILIACEÆ.	
Smilacina Racemosa, Desf.	Uniacke, Hants; Rev. J. B. U.
Clintonia borealis, Raf.	Pembroke, Hants.
JUNCACEÆ.	
Juncus bulbosus, L.	Windsor.

In conclusion, I may direct attention to a list of "83 varieties of various woods grown in the Province," published in the catalogue of the N. S. department, International Exhibition, 1862, by Amos Fales, Jr., Wilmot.

List of the rarer plants collected at Glace Bay, C. B., by Henry Poole, Esq.:—

Ranunculus Cymbalaria, Pursh.
Actæa spicata, L.
Viola pubescens, Ait.
Lotus corniculatus, L. Eur.
Lathyrus maratimus, Bigelow.
Comarum palustre, R.
(Potentilla palustris, Ait.)
Potentilla anserina, L.
P. tridentata, Ait.
Mitella nuda, L.
Cotyledon umbilicus? L.
Nardosomia palmata, Hook.
Lobelia Kalmii, L.
Campanula rotundifolia, L.
Moneses uniflora, Salisb.
Statice limonium, L.
Chelone glabra, L.
Veronica scutellata, L.
V. Americana, Schweinitz.
V. officinalis, L.
Euphrasia officinalis, L.
Echium vulgare, L.
Mertensia maritima, Don.
Cypripedium spectabile, Swartz.
Calopogon pulchellus, R. Brown.
Equisetum pratense, Ehrh.
Aspidium (Lastrea,) Thelypteris, Swartz.

Pyrola rotundifolia, L.
P. elliptica, Nutt.
P, secunda, L.
Aspidium Filix-mas, Swartz.
Marchantia polymorpha, L.

In the notes appended to the list, I omitted to mention Lobelia, Kalmii, as an addition to the flora, not being observed by any other Provincial collector.

The object of the foregoing list is no doubt that of presenting an additional location for species already described, since all contained therein, with the exception of seventeen, will be found in the catalogue appended to vol. IV., p. II., of our Transactions, 1875 and 1876. The major part of them have not been before credited to Hants County, although the species in the present list from other places appear in the catalogue under their respective localities. Of the seventeen additional species denoted by italics, five are cultivated exotics, and two are garden escapes, leaving twelve to be accounted indigenous additions to the Provincial Flora.

I may be excused for remarking here upon the concluding notes of Prof. How's preface, viz., those furnished him by Mr. Thompson, affording as they do, an example of error, to which all are liable by generalizing from a narrow field of observation. In one place, he remarks upon what seemed to him a total absence of Gaultheria, procumbens, and of its substitution by chiogenes. Such a circumstance may be true of Scot's Bay, but it would be wrong to imply that the same held good for the whole Province. A reference to the published catalogue gives as localities, Hants, Halifax, Guysborough. It is very plentiful in Halifax county, and can be found within convenient distance from the city. It is moreover more abundant than chiogenes, although yver often they accompany each other. Likewise, he notices the absence of Rhodora Canadensis, scarcely excepting the Vacciniæ, the most abundant and wide-spread of our Heathworts. The failure was, no doubt, owing to the season at which the locality was under observation. The Rhodora, it must be remembered, is an early bloom, putting forth, previous to leafing. It is usually out of blossom by the time that its leaves are fully expanded. It is rare to find a specimen for the Herbarium with perfect flowers and leaves together. Those, who in early Spring observe the purpling of our roadsides and field borders by its masses of bloom can never separate it from our landscapes. In the catalogue it is denoted in all localities observed. *Mitchella repens*, also referred to, is by no means scarce, as the catalogue shows, though truly less abundant than Cornus Canadensis, an observation which obtains for those parts of the New England States which I have visited. As for Juniperus communis, the botanist who struggles through uncultivated pastures or pine openings, etc., in quest of plants, is in this locality, (Halifax), at least, unpleasautly reminded of its abundance.

The interest attaching to Mr. Poole's list arises from the presence there of two foreign species, both occurring in the British Flora, but not before described as American, at least we fail to find them in the books on American Botany. These are Lotus corniculata Ord. Leguminosæ, and Cotyledon umbilicus, Ord. Crassulaceæ. We may conclude with safety that both are importations, derived from Britain, like a host of others, which to all appearance are indigenous; both orders supply us with many introduced plants which have spread themselves either widely or in very few localities. We have in this locality (Halifax) Medicago, Vicia, etc., of the Leguminous order, now spontaneous. Sedum, acre, and S. rhodiola of the Crassulaceæ in like circumstances. I noticed recently, also, the occurrence Linaria vulgaris, in two places near Halifax, viz., the termination of the Coburg Road, and a fallow field on the Chebucto Road.

We cannot attach too much importance to the separation of our indigenous species from those which have been introduced, the latter are annually encroaching upon the former, and are in many instances supplanting them, being aided by the increase of our agricultural area, and the destruction of the forests. Our efforts should be at the present time directed towards collecting and recording the existence of native plants, leaving the others for future effort. To me it seems as unscientific to include introduced plants in our list of aboriginal species, as it would be to enumerate our domestic animals as being members of our native fauna. I am therefore, compelled to confess that the published catalogue to which

I have so often referred, contains many such species presented without explanation as to their origin. The list which formed the basis of this catalogue was prepared by myself, and contained very few species, not indigenous, but in its subsequent compilation the numerous additions from other sources caused the introduction of many species not of native origin, many of which are presented without comment, a circumstance, which was owing to the short time afforded for preparation for the press, along with other exigencies which prevented me from giving it that amount of attention and care which it deserved.

The foregoing explanation is deemed to be requisite for those who cannot avoid observing the errors referred to.

J. SOMMERS,
For Editing Com.

ART. IX.—MOLLUSCA OF NOVA SCOTIA, (CORRECTED TO DATE, 1877.) BY J. MATTHEW JONES, F. L. S.

CLASS CONCHIFERA.

Fam. PHOLADIDÆ. Leach.

Teredo navalis, L. This species is inserted in Mr. Willis's privately printed list with a query. It was taken from a log in a spar-yard at Dartmouth. Marine Slip timbers at Pictou. (*Whiteaves.*)

T. dilatata, St. Very large specimens have been received from Sable Island, taken from wreck timber. (*Willis.*)

T. Norvagica, Speng. Marine Slip timbers at Pictou. (*Whiteaves.*)

Zirphœa crispata, Morch. Large specimens have been received from Sable Island. (*Willis.*)

Fam. SOLENIDÆ.

Ensatella Americana, Verrill. Sandy shores; whole coast.

Siliqua squama, St. Fishing banks; rare. (*Willis.*)

S. costata, Ad. Fishing banks. (*Willis.*)

Solenomya velum, Say. Fishing banks; very rare. (*Willis.*)

S. borealis, Tott. Fishing banks; very rare. (*Willis.*) Halifax harbour; rare. (*Verrill.*)

Panopœa arctica, Gould. Halifax harbour.

Glycymeris siliqua, Lam. Halifax harbour. Sable Island beach; dead specimens. .(*Willis.*)

Fam. MYADÆ.

Mya arenaria, L. Halifax harbour, etc.; very common.

M. truncata, L. Halifax harbour; not uncommon.

Fam. CORBULIDÆ.

Corbula contracta, Say.

Neœra arctica. La Have banks.

Fam. PANDORIDÆ.

Clidiophora trilineata, Carp. Halifax harbour; rare. I have only dredged stray valves.

Northumberland Strait, north of Pictou Island. (*Whiteaves.*)

Fam. ANATINIDÆ.

Lyonsia arenosa, Morch. Halifax harbour.

Periploma papyracea, Verrill. Sable Island. (*Willis.*)

Cochlodesma leanum, St. Fishing banks. (*Willis.*)

Thracia Conradi, Couth. Fishing banks. (*Willis.*)

T. myopsis, Beck. Halifax harbour. (*Smith* and *Harger.*) Fishing banks. (*Willis.*)

T. truncata, Migh and Ad. Fishing banks. (*Willis.*)

Fam. MACTRADÆ.

Mactra solidissima, Chemn. Sandy beaches; whole coast. I have a specimen in my collection, presented to me by the late Mr. Willis, measuring in length 7¼ inches, and 6½ inches in extreme breadth. It came from Sable Island.

M. ovalis, Gould. Sable Island. (*Willis.*)

Mulinia lateralis, Gray.

Ceronia arctata, Ad. Sable Island. (*Willis.*)
C. deaurata, Gould. Sable Island. (*Willis.*)

Fam. KELLIADÆ.

Kellia planulata, St. Sable Island. (*Willis.*)
K. suborbicularis, Turt. Sable Island. (*Willis.*)
Turtonia minuta, Ald. Sable Island. (*Willis.*)

Fam. GASTROCHÆNIDÆ.

Saxicava arctica, Desh. Whole coast; common.
Petricola pholadiformis, Lam. Sable Island. (*Willis.*) Northumberland Strait, off North Shore. (*Whiteaves.*)

Fam. TELLINIDÆ.

Macoma fusca, Gould. Halifax harbour. Fishing banks. (*Willis.*)
M. sabulosa, Morch. Halifax harbour. (*Smith* and *Harger.*) Fishing banks. (*Willis.*)
Tellina tenera, Say. Fishing banks. (*Willis.*)

Fam. LUCINIDÆ.

Cryptodon Gouldii, St.

Fam. CYCLADIDÆ.

Sphærium simile, Gould. Truro, N. S. (*McCulloch.*)
S. partumeium, Prime. Fresh-water lakes; common.
Pisidium dubium, Gould. Fresh-water lakes.

Fam. CYPRINIDÆ.

Astarte castanea, Say. Halifax harbour. Sable Island. (*Willis.*) Off Cape Sable. (*Verrill.*)
A. crebricostata, Forbes and Hanley. Halifax harbour.
A. sulcata, Flem. Halifax harbour.
A. semisulcata, Gray.
A. elliptica, McGilliv. LaHave Bank. (*Smith* and *Harger.*)
A. Banksii, Leach. LaHave Bank. (*Smith* and *Harger.*)
A. undata, Gould. Northumberland Strait, off North Shore. (*Whiteaves.*)

Cyprina Islandica, Lam. Halifax harbour; common. Northumberland Straits, off North Shore. (*Whiteaves.*)

Fam. VENERIDÆ.

Callista convexa, Ad. Halifax harbour. Sable Island. (*Willis.*)

Venus mercenaria, L. Whole coast; common.

Tapes fluctuosa, Desh. Fishing banks. (*Willis.*)

Tottenia gemma, Perkins.

Fam. CARDIADÆ.

Cardium Islandicum, L. Halifax harbour.

Cardium pinnulatum, Conr. Halifax harbour. Northumberland Strait, off North Shore. (*Whiteaves.*)

Lævicardium Mortoni, Verrill. Halifax harbour.

Serripes Grönlandicus, Beck. Halifax harbour. St. Margaret's Bay. (*Willis.*)

Cyclocardia borealis. Fishing banks. (*Willis.*)

Fam. ARCADÆ.

Arca pectunculoides. Off Halifax harbour.

Nucula tenuis, Turt. Sambro Banks. (*Willis.*)

N. proxima, Say. Fishing banks. (*Willis.*)

N. delphinodonta, Migh. Northumberland Strait, off North Shore. (*Whiteaves.*)

Yoldia limatula, St. Fishing banks. (*Willis.*) Northumberland Strait, off North Shore. (*Whiteaves.*)

Y. obesa, St. Halifax harbour.

Y. thraciæformis, St. Halifax harbour.

Y. sapotilla, St. Halifax harbour. Northumberland Strait, off North Shore. (*Whiteaves.*)

Y. myalis, Gould. St. Mary's Bay, Digby Co. (*Verkruzen.*)

Leda tenuisulcata, Couth. Halifax harbour.

L. minuta, Mol.

L. caudata, Loven.

Fam. UNIONIDÆ.

Unio complanatus, Lea. Fresh water lakes and streams.

U. radiatus, Barnes. Grand Lake. (*Willis.*)

Margaritana arcuata, St. Fresh water lakes and streams.

Anodon implicata, Gould. Inland lakes; rare. (*Willis.*)

Fam. MYTILIDÆ.

Mytilus, edulis, L.

var, *pellucida.* All rocky shores.

Modiola modiolus, Turt. All rocky shores.

M. plicatula, Lam. Northern coast. (*Willis*).

Modiolaria nigra, Loven. Halifax harbour.

M. discors, Beck. Halifax harbour.

M. corrugata, Morch. Halifax harbour.

Crenella glandula, Ad. Halifax harbour. (*Willis*).

C. nigra. Northumberland Strait, off Pictou Island. (*Whiteaves*).

Fam.. PECTENIDÆ.

Pecten tenuicostatus, Migh and Ad. Whole coast. One in my collection, presented by the late Mr. Willis, measures over 6¼ in.

P. islandicus, Chemn. Whole coast.

P. irradians, Lam. Sable Island. (*Willis*).

P. pustulatus. LaHave bank. (*Willis*).

Fam. OSTRÆIDÆ.

Ostrœa virginiana, List. Northern coast.

Anomia glabra, Verrill. Halifax harbour Off Cape Sable, 8 fath. (*Verrill*).

A. aculeata, Gmel.

A. electrica, L.

A. squamula, L.

CLASS BRACHIOPODA.

Fam. TEREBRATULIDÆ.

Terebratulina septentrionalis, Couth. I have found this species very abundant in one particular part of the harbour; adult and young, in all stages of growth together, generally much covered by a sponge; 10 fath.

Fam. Rhynconellidæ.

Rhynconella pisttacea, Owen. St. Margaret's Bay, LaHave Bank, *(Smith* and *Harger),* Halifax harbour, *(Smith* and *Harger)*

Waldheimia cranium, Gd. One single specimen only has yet been obtained on our coast, at St. Margaret's Bay.

CLASS GASTEROPODA.

Fam. Bullidæ.

Philine quadrata, Searles Wood. Fishing banks. *(Willis).*
P. lineolata, St. Fishing banks. *(Willis).*
Scaphander puncto-striatus, St. Fishing banks. *(Willis)*
Diaphana debilis, St. Fishing banks. *(Willis).*
Utriculus pertenuis, St. Fishing banks. *(Willis).*
Cylichna alba, St. Fishing banks. *(Willis).*

ORDER NUDIBRANCHIATA.

Fam. Tritonidæ.

Dendronotus arborescens, Ald. and Han. Halifax harbour.

D. robustus, Verrill. Thirty miles S. E. from Chebucto Head; 110 fathoms.

Eolis nana? Ald. and Han. Piles, Halifax harbour. Verrill.

Fam. Chitonidæ.

Trachydermon ruber, Carp. Halifax harbour.
T. marmoreus, Fabr. Halifax harbour.
T. albus, Lowe. Halifax harbour.
Amicula Emersonii, St. Halifax harbour.

Fam. Dentalidæ.

Siphonodentalium —— ? La Have Bank.

Fam. Patellidæ.

Acmœa testudinalis, Forbes and Hanley. All rocky shores.
Lepeta cœca, Gd. Fishing banks; very rare. *(Willis.)*

Fam. CALYPTRÆIDÆ.

Crepidula fornicata, Lam. Whole coast.

C. plana, Say. Sable Island; Northern shores; Bay of Fundy. (*Willis.*) La Have Bank. (*Smith* and *Harger.*)

C. convexa, Say. Sable Island. (*Willis.*)

Fam. FISSURELLIDÆ.

Cemoria Noachina, Gd. Fishing banks. (*Willis.*)

Fam. JANTHINIDÆ.

Janthina fragilis, Desh. Sable Island; occasionally as a drift shell.

Fam. TROCHIDÆ.

Margarita cinerea, Gd. Fishing banks. (*Willis.*)

M. undulata, Sow. Fishing banks. (*Willis.*)

M. helicina, St. Halifax harbour.

M. argentata, Gd.

M. obscura, Gd.

M. varicosa, Migh. and Ad. Halifax harbour. (*Smith* and *Harger.*)

Fam. PALUDINIDÆ.

Valvata tricarinata, Say. Lakes in the interior.

Melantho decisa, W. G. Binney. Dartmouth lakes, &c.

Amnicola limosa, Hald. Ponds and stagnant waters.

Fam. LITTORINIDÆ.

Skœnea planorbis, Forbes and Hanley.

Lacuna vincta. Gd. Whole coast.

Littorina rudis, Gd. All rocky shores.

L. tenebrosa, Gd. All rocky shores.

L. littorea, Johnston. All rocky shores.

L. palliata, Gd. All rocky shores.

Fam. SCALARIDÆ.

Scalaria Graoenlandica, Sow. Halifax harbour, LaHave Bank, (*Smith* and *Harger*).

Fam. TURRITELLIDÆ.

Turritella erosa, Couth. Fishing banks. *(Willis).*
T. reticulata, Migh and Ad. Halifax harbour.
T. acicula, St. Halifax harbour.

Fam. CERITHIIDÆ.

Aporrhais occidentalis. Sow. Halifax harbour, LaHave Bank, *(Smith* and *Harger),* Annapolis Basin, *(Verkruzen).*
Bittium nigrum, St. Whole coast.

Fam. PYRAMIDELLIDÆ.

Turbonilla interrupta, Tott. Northumberland Strait; north shore, *(Whiteaves).*
Menestho albula, Möll. Fishing banks; rare. *(Willis).*

Fam. VELUTINIDÆ.

Velutina haliotoidea, Gd. Fishing banks. *(Willis).*
V. zonata, Gd. Halifax harbour.

Fam. NATICIDÆ.

Lunatia heros, St. All sand beaches.
L. Groenlandica, Gd.
Natica clausa, Brod. and Sow. Halifax harbour.
Lunatia immaculata, Ad. Fishing banks. *(Willis).* Northumberland Strait, off Pictou Island, *(Whiteaves).*
Bulbus flavus, St. Fishing banks. *(Willis).*
Amauropsis helicoides, St. Fishing banks. *(Willis).*

Fam. TURRITIDÆ.

Pleurotoma plicata, Ad. Fishing banks. *(Willis).*
Bela turricula, St. Fishing banks. (*Willis*).
B. harpularia, St. Halifax harbour.
Bela violacea, St. Fishing banks. *(Willis.)*
B. decussata, St. Fishing banks. *(Willis.)*
B. pleurotomaria, St. Halifax harbour.
B. cancellata, St. Northumberland Strait. *(Whiteaves.)*

Fam. COLUMBELLIDÆ.

Astyris rosacea, H. & A. Ad. Fishing banks. *(Willis.)*

Fam. PURPURIDÆ.

Purpura lapillus, Lam. All rocky shores.

Ilyanassa obsoleta, St. Halifax harbour; Pictou; Annapolis Basin.

Tritia trivittata, Ad. Halifax harbour; Northumberland Strait, off Pictou. *(Whiteaves.)*

Buccinum undatum, L. Whole coast.

B. ciliatum, Gd. Fishing banks. *(Willis.)*

Fam. MURICIDÆ.

Neptunea curta, Verrill. Halifax harbour.

Neptunella pygmæa, Verrill. Halifax harbour.

Neptunea ventricosus, Gray. Sable Island.

N. decemcostatus, Halifax harbour; LaHave bank. *(Verrill.)*

Trophon clathratus, St. Halifax harbour.

T. scalariformis, Gd. Halifax harbour.

T. Gunneri, LaHave bank. *(Smith* and *Harger.)*

Ptychatractus ligatus, St. Halifax. *(Willis.)*

Fam. CANCELLARIDÆ.

Trichotropis borealis, Sow. Halifax harbour.

Admete viridula, St. Fishing banks. *(Willis.)*

SUB-CLASS PULMONIFERA.

Fam. HELICIDÆ.

Hyalina cellaria, Morse. Halifax; scarce. (*Willis.*)

H. arborea, Morse. Neighbourhood of Halifax; scarce. (*Willis.*)

H. electrina, Morse, do. do.

H. chersina, Binney, do. do.

H. lineata, Binney, do. do.

Helix alternata, Say. Only found in the interior of the country and not on the Atlantic Coast.

H. striatella, Anth. Neighbourhood of Halifax; scarce. (*Willis.*)
H. hirsuta, Say. do. common.
H. pulchella, Müll. do. not uncommon.
H. hortensis, Müll. Whole country; common. The yellow variety is far more abundant than the striped.
Succinea obliqua, Say. Stagnant waters; Halifax, &c.
S. avara, Say. do. do.

Fam. AURICULIDÆ.

Alexia myosotis, Pf.

Fam. LIMNÆIDÆ.

Limnæa columella, Say. In most lakes and ponds; common.
L. elodes, Say. Truro marshes: common.
L. catascopium, Say. Dartmouth Lakes; rare. (*Willis.*)
L. humilis, Say. Pond at Fort Needham, Halifax.
Physa heterostropha, Say. Truro marshes; common.
P. ancillaria, Say. Dartmouth Lakes. (*Willis.*)
Bulinus elongatus, Binney. Truro marshes; not common.
Planorbis trivolvis, Say. Dartmouth Lakes; common.
P. bicarinatus, Say. do.
P. deflectus, Say. do.
P. dilatatus, Gould. do.
Ancylus parallelus, Hald. Fresh water lakes and streams; common.

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

PATRON—His Honor The LIEUTENANT GOVERNOR.

COUNCIL, 1876-7.

J. B. GILPIN, B. A., M. D., M. R. C. S., *President.*
WILLIAM GOSSIP, FREDERICK ALLISON, M. A. } *Vice-Presidents.*
REV. D. HONEYMAN, D. C. L., F. G. S., JOHN T. MELLISH, M. A. } *Secretaries.*
W. C. SILVER, *Treasurer.*

A. P. REID, M. D.
J. SOMMERS, M. D.
L. G. POWER.
ROBERT MORROW.
J. M. DEWOLFE, M.D., M.R.C.S.
SHERIFF BELL.
PROFESSOR LAWSON.
AUGUSTUS ALLISON.

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. IV. 1875-76. PART I.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 87 GRANVILLE ST.
ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.
UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.
1876.

Price. Five Shillings.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART I.

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

ANNIVERSARY MEETING.

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

Inter Alia.

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

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

Vice-Presidents—WM. GOSSIP, FRED. ALLISON, M. A.

Secretaries—REV. D. HONEYMAN, D. C. L., F. G. S., A. ROSS.

Council—Rev. Dr. WARREN, A. P. REID, M. D., Rev. A. S. HUNT, M.A., ROBERT MORROW, G. LAWSON, Ph. D., L. L. D., J. R. DEWOLF, M. D., M. R. C. S., Sheriff BELL, AUGUSTUS ALLISON.

ORDINARY MEETING, 9th Nov., 1874.

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

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

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

ORDINARY MEETING, Dec. 14, 1874.

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

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

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

ORDINARY MEETING, Jan. 11, 1875.

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

The SECRETARY announced that the following gentlemen, proposed at a previous meeting, had been duly elected members: JOHN FORBES, JOHN T. MELLISH, M. A., J. SOMERS, M. D., and ANDREW DEWAR.

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

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

ORDINARY MEETING, March 8, 1875.

A. ROSS *in the Chair.*

The SECRETARY announced that the Council had elected A. H. MCKAY, B. A., an Associate Member.

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

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

ORDINARY MEETING, April 12, 1875.

The PRESIDENT *in the Chair.*

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

ORDINARY MEETING, May 10, 1875.

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

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

JOHN T. MELLISH,
Secretary.

LIST OF MEMBERS.

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

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

ASSOCIATE MEMBERS.

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

CORRESPONDING MEMBERS.

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

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—A MONTH AMONG THE GEOLOGICAL FORMATIONS OF NEW BRUNSWICK. BY REV. D. HONEYMAN, D. C. L., F. G. S., &c., *Director of the Provincial Museum, Halifax.*

(*Read November* 9, 1874.)

SAINT JOHN.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ST. JOHN TO BATHURST.

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

SOMERSET VALE

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

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

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

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

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

NEPISIGUIT RIVER.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SOMERSET VALE TO D LHOUSIE.

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

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

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

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

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

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

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

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

1.—That the Trap of Cape Bon-ami and Niagara Limestone are not contemporaneous.
2.—That the formation of the Trap was posterior to that of the Niagara Limestone.
3.—That the Trap was in molten state when the fossils detached from the sedimentary strata dropped into it.
4.—That organic structure may be preserved in molten Trap, especially when in a condition adapted for the formation of Amygdaloid.

POST PLIOCENE.

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

I also noticed the first cutting across the Tattagouche.

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

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

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

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

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

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

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

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

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

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

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

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

ART. II.—ON THE SMALLER CETACEANS INHABITING THE BAY OF FUNDY AND SHORES OF NOVA SCOTIA. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read Jan.* 11, 1875.)

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

ORDER:

CETACEÆ.

FAMILY:

DELPHINNIDÆ.

Delphinus delphis. Linn. Cuvier. Gray.

DOLPHIN OF ALL SEAS:

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

WHITE SIDED DOLPHIN. SEA PORPOISE.

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

THE PORPOISE.

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

WHITE WHALE.

FAMILY:

GLOBIOCEP HALIDE.

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

AMERICAN BLACK-FISH.

Delphinus delphis. Dolphin of all Seas.

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

Lagenorhyncus Leucoplurus.

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

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

The other fish was rather larger, but agreed in form and colour. In form they were very round. The forehead sloped upwards from a beak or snout, in a convex line to the back fin which was falcate.

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

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

Phocœna communis,
Phocœna tuberculifera,

COMMON PORPOISE.—PUFFIN PIG.

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

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

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

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

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

From occiput to tip of nose	9½	inches.
Greatest width of maxilla bones	5	"

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

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

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

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

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

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

Beluga catadon.

White Whale.

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

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

Globiocephalus intermedius.

American Black Fish.—Bottle Nose.

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

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

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

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

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

(*Read April* 12, 1875.)

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

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

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

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

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

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

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

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

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

*Belfast Address.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(*Read May* 10, 1875.)

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

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

General Meteorological Register for 1874.

HALIFAX, NOVA SCOTIA.

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

OBSERVED BY F. ALLISON.

1874.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year 1874
Mean Temperature	27.15	19.85	30.78	33.39	49.19	53 66	62 45	61 33	57.42	48.74	36.77	26.21	42.25
Difference from Normal (twelve years)	+3.82	-3.24	+2.10	-4.34	+1.60	+5.14	-.94	-1.73	4.04	+.36	-.68	+ 42	-.61
Maximum Temperature	51.0	46.2	53.7	63.8	81.6	79.2	86.0	85.7	79 8	69.6	57 6	48.1	86.0
Minimum Temperature	-15.8	-11 5	-9.0	7.2	30 0	36.5	43.3	43 6	40 0	27.3	12.3	-4.0	-15.8
Monthly and Annual Ranges	66.8	57.5	62.7	46.6	51.6	42.7	42.7	42.1	39.8	42.3	45.3	52 1	101.8
Mean Maximum Temperature	36.48	29.76	41.16	42.50	62.01	64.26	75.56	73.67	69 35	60 00	45.01	34.23	52 88
Mean Minimum Temperature	18.93	9.52	22.27	25.53	38.69	45.57	53.51	52.51	49.36	40.11	28.90	17.86	38.56
Highest Daily Mean Temperature	45.80	40.05	43.07	41.94	61.30	63.83	69.23	67.42	62.56	66.81	60 61	44 37	69.23
Lowest Daily Mean Temperature	-7.39	-4.70	14.01	19 55	40.44	45 79	49.91	54.89	50.55	37.32	23.74	3.86	-7.39
Mean Daily Range of Temperature	17.55	20.24	18.88	16 97	23.33	18.69	22.05	21.16	19.99	19.89	16.11	16.31	19.26
Greatest Daily Range of Temperature	40.7	40.0	38.9	27 8	38.1	34.9	33.8	30.8	35.0	29.7	28.1	26 6	40.7
Mean Pressure, corrected.	29 977	29.841	29.658	29.792	29.785	29.767	29.895	29.854	29.936	29 862	29.900	29.791	29.838
Difference from Normal, (twelve years)	+.210	+.080	-.051	+.061	+ 069	+.006	+ 117	+.069	+.080	+.038	+.158	+.027	+.065
Maximum Pressure	30.604	30 602	30.309	30 254	30.204	30.206	30 161	30.200	30 373	30.430	30.480	30.455	30.604
Minimum Pressure	29.173	28.830	28.896	28.951	29.216	29.242	29.501	29.414	29.234	29.072	28.985	28.898	28.830
Monthly and Annual Ranges	1.431	1.772	1.413	1 303	0.988	0 964	0.660	0.786	1.139	1.358	1.495	1.557	1.774
Highest Daily Mean Pressure	30.536	30.566	30.271	30.155	30.132	30.150	30.146	30.142	30.347	30 349	30.426	30 397	30.566
Lowest Daily Mean Pressure	29.368	29.042	28.943	29.251	29.283	29.363	29.586	29 496	29.378	29.274	29.146	29.180	28.943
Mean Pressure of Vapour	.146	100	.143	.152	.248	.338	.459	.442	.396	.287	.182	.129	.252
Mean Relative Humidity	83.0	77.4	79.9	79.2	71.2	81.6	81.4	81.4	83.4	81.9	78.9	81.0	80.2
Mean Amount of Cloud	6.97	5.52	5.35	6.08	6.00	7.30	6.66	6.47	5.51	4.88	6.85	6.60	6.02
Difference from Normal, (eight years)	+60	-.50	-.41	-.24	-1.55	+1.19	+.04	+.88	-.17	-.49	-.67	-.05	+.03
Prevalent Direction of Wind	S.W.	N.W.	N W.	S.W.	S.W.	S.E.	S.W.	S.	N.W	S.W.	W.	W.	W.S.W.
Mean Velocity of Wind	6.09	6.60	5.99	6.37	6.38	5.37	3.85	4 25	4.97	4.48	8.40	10.92	6.06
Difference from Normal, (four years)	-2.64	-2.28	-4.70	-1.80	-3.07	-.81	-.80	-.29	-.42	-1.67	-1.63	+2.90	1.67
Amount of Rain	3.80	2 28	3.63	1.90	4.76	7.92	2.29	3.37	5 04	2.46	3.37	4.42	45.24
Difference from Normal, (twelve years)	+.11	-.76	+.70	-1.00	+.69	+4.46	-.20	-.29	+1.17	-2.74	-1.43	+1.00	+1.80
Number of days Rain	13	4	8	10	13	20	12	12	12	13	10	13	1.40
Difference from Normal, (twelve years)	+6	-2	+3	0	-2	+6	+1	+1	+2	+1	-2	+4	+16
Amount of Snow	15.7	29.9	3.7	26.5	0.1	0	0	0	0	0	2.1	11 0	89.0
Difference from Normal, (twelve years)	- 8	+14 8	-13.6	+17 3	-0 6	0	0	0	0	-.5	-2.1	-5 7	+8.2
Number of days Snow	12	11	7	13	1	0	0	0	0	0	4	12	60
Difference from Normal, (twelve years)	+2	+3	-4	+7	0	0	0	0	0	-2	0	+1	+12
Total Precipitation	5.42	6.31	.98	4.55	4.77	7.92	2.29	3.87	5.04	2.46	3.58	6.49	54.18
Difference from Normal, (twelve years)	-.24	+.01	-.44	+.61	+.70	+4.48	-.20	-.29	+1.17	-2.74	-1.69	+.58	+1.95
Number of Dry Days	12	15	17	12	18	10	19	19	18	18	18	12	188
Difference from Normal, (twelve years)	-5	-1	-1	-5	+2	-6	-1	-1	-2	-2	+3	-2	-16
Number of Auroras	1	4	3	6	0	4	2	0	4	4	1	0	28
" Gales	4	3	1	4	1	0	0	0	1	1	2	1	18
" Fogs	6	2	2	0	3	7	10	7	8	5	2	1	48
" Dews	2	0	1	0	0	2	4	10	14	13	1	0	47
" Hoar Frosts	9	10	7	9	4	1	0	0	0	6	11	6	63
" Thunders	0	0	0	0	0	2	2	1	0	1	1	0	7
" Lightnings	0	0	0	0	1	2	2	1	0	1	1	0	8
" Hails	0	0	0	0	0	1	0	0	0	0	0	0	1
" Rainbows	0	0	0	0	0	0	2	1	0	0	0	0	3
" Lunar Halos	0	1	3	0	0	1	0	0	2	0	1	1	8
" Lunar Coronæ	3	3	2	2	0	0	0	0	1	0	0	0	11
" Solar Halos	1	0	0	0	0	0	2	0	1	0	2	0	8
" Days Sleighing.	16	28	8	10	0	0	0	0	0	0	0	7	64

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

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

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

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

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

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

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

On 64 days we had fair sleighing.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ART. V.—NOVA SCOTIAN GEOLOGY — ANTIGONISHE COUNTY.

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(*Read May* 10, 1875.)

INTRODUCTION.

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

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

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

Antigonishe County

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

Arisaig

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

Arisaig Township.

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

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

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

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

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

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

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

GEOLOGY.

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

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

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

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

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

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

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

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

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

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

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

SECTION 3RD.—*McNeil's Brook.*

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

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

From this the brook passes eastward to the last section.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SECTION 9TH.—*Smith's Brook.*

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

SECTION 10TH.—*McAdam's Brook.*

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

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

SECTION 11TH.—*McAra's Brook.*

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

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

This ends the section.

RETURN TO ARISAIG.

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

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

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

KNOYDART BROOK.

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

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

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

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

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

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

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

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

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

This is the beginning of section 1st.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

We have now reached the end of our coast section.

Knoydart Brook, Pictou Co.

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

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

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

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

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

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

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

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

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

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

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

A } wanting,
B }
B′
C — Upper series.
B
A
Diorite (Trap),

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

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

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

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

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

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

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

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

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

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

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

CORRELATION.

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

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

These are the undoubted equivalent of the series in question.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

This is the eastern terminus of a formation which extends into the township of Dorchester in the form of an isosceles triangle, its base commencing at a distance of 1½ miles from Antigonishe(Town), and extending to the north a further distance of 4½ miles. About two miles to the west of this base we have what may be *strict'y* regarded as a continuation of the same formation. The intervale is occupied by lower carboniferous conglomerate and grits, which doubtless overlap and obscure the underlying connection. This continuation beginning on the north in the Arisaig mountains, extends southward to a distance of about two miles north-west of Antigonishe, bounding Pleasant Valley and the *north carboniferous area* of Antigonishe on the west.

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

About a mile south-west of the *outcrop of the section*, the range of mountains commences and continues to Antigonishe, their culmination being the Sugar Loaf, 760 feet above the sea level. The summit of the Sugar Loaf is an igneous rock—diorite. About 2½ miles north of the Sugar Loaf is another igneous centre. Appearing first on the fields and brooks at Donald McDonald's (Brook), it extends westward, outcropping and joining a lofty bluff on the east of Right's River. Here the rock is *amygdaloidal*. It is uncertain whether the diorite of the *outcrop* is the extension of the first or second, or of both. I have heretofore regarded it as the continuation of the second. I regard this eruption as contemporaneous with that of the diorite of McLellan's Mountain and Sutherland's River as post Upper Silurian and pre-carboniferous—*Devonian*, and the metamorphic slates as metamorphosed Middle and Upper Silurian, according to the analogy of East River, Pictou, McLellan's Mountain, &c.—(*Transactions* 1870-71.)

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

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

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

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

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

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

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

SALINE.

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

HISTORY OF THE SALTWORKS.

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

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

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

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

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

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

SECTION 8.—*Continued.*

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

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

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

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

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

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

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

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

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

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

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

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

VOLCANIC.

This county indicates volcanic action :

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

TRANSPORTATION.

Post pliocene.

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

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

Recent.

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

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

(*To be continued.*)

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

By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read April*, 1875.)

FAMILY—Colubridæ.

Genus—Eutania.
Eutania sirtalis. B. & G.
Coluber sirtalis. Linn.
Garter Snake.

Genus—Bascanion.
Bascanion constrictor. B. & G.
Black Snake.

Genus—Chlorosoma.
Chlorosoma vernalis. B. & G.
Green Snake.

Genus—Diadolphis.
Diadolphis punctatus. B. & G.
King Snake.

Genus—Storeria.
Storeria occipitomaculata. B. & G.
Red-bellied Snake.

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

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

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

The Garter Snake.

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

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

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

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

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

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

The Black Snake.

Bascanion constrictor. B. & G.

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

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

The Green Snake.

Chlorosoma vernalis. B. & G.

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

The King Snake.

Diadolphis punctatus. B. & G.

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

Red Bellied Snake.

Storeria occipitomaculata. B. & G.

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

This ends our list of Nova Scotia serpents.

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

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

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

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

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

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

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

Art. VII.—The Southern Synclinal of the Pictou Coal Field. By Edwin Gilpin, M. A., F. G. S., &c., &c.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The analysis gave the following results :—

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

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

Theoretical evaporative power.. 8.858 lbs.

Specific gravity 1.29

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

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

II. Rapid Coking.

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

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

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

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

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

II. *The 6 foot Seam.*

This seam is the property of the General Mining Association.

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

The analysis gave the following results :—

Ordinary coking (air-dry specimen).

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

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

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

NOVA SCOTIAN [illegible]E OF NATURAL SCIENCE, HALIFAX, NOVA SCOTIA.

PATRON—His Excellency 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.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

OF

HALIFAX, NOVA SCOTIA.

VOL. IV. 1875-76. PART II.

CONTENTS.

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UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.

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PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART II.

Provincial Museum, Oct. 13, 1875.

ANNIVERSARY MEETING.

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

Inter alia.

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

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

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ORDINARY MEETING, Nov. 13, 1875.

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

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

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

ORDINARY MEETING, Dec. 13, 1875.

The PRESIDENT *in the Chair.*

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

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

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

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

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

Ordinary Meeting, January 10, 1876.

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

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

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

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

Ordinary Meeting, February 14, 1876.

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

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

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

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

Ordinary Meeting, March 13, 1876.

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

The Secretary announced that J. T. Fraser and Robert S. Skimmings, had been elected members of the Institute; and that the Rev. G. Patterson, D. D., of Pictou; J. B. Calkin, M. A., Principal of Normal School, Truro; and James J. Kerr, had been elected associate members.

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

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

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

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

Ordinary Meeting, April 10, 1876.

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

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

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

April 24, 1876.

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

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

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

Ordinary Meeting, May 8, 1876.

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

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

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

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

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

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

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

John T. Mellish,
Secretary.

LIST OF MEMBERS.

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

1866. Feb. 1. Kelly, John, *Dep. Chief Commr. of Mines*, Halifax.

64. Mar. 7. Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, Dalhousie College, Halifax.

75. Jan. 1. Mellish, John T., M. A., SECRETARY, Halifax.

72. Feb. 5. McKay, Alexander, *Principal of Schools*, Dartmouth.

72. Feb. 12. McKay, Adam, Engineer, Dartmouth.

66. Feb. 3. Morrow, James B., Halifax.

72. Feb. 13. Morrow. Robert, Halifax.

73. Mar. 10. Moseley, E., Dartmouth.

70. Jan. 10. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.

65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., *Lord Bishop of.*

74. Mar. 9. Pitts, D. H., Halifax.

63. Jan. 16. Poole, Henry, M. E., Derbyshire, Eng.

72. Nov. 11. Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.

70. Jan. 20. Power, L. G., Barrister-at-Law, Halifax.

66. July 28. Reeks, Henry, Manor Hall, Truxton, Hamp., England.

71. Nov. 29. Reid, A. P., M. D., Halifax.

74. Nov. 9. Robertson, Thomas, Halifax.

66. Jan. 8. Rutherford, John, M. E., Halifax.

64. Mar. 7. Silver, W. C., TREASURER, Halifax.

68. Nov. 25. Sinclair, John A., Halifax.

76. Mar. 13. Skimmings, Robert, Halifax.

75. Jan. 11. Somers, J., M. D., Halifax.

74. Apr. 11. Stirling, W. Sawers, Halifax.

73. Jan. 13. Waddell, W. Henry, Fort Massey Academy, Halifax.

74. Nov. 9. Walker, John McAra, Saint John and Halifax.

66. Mar. 18. Young, Sir William, Knt., *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 6. Ambrose, Rev, John, A. M., Digby.

76. Mar. 13. Calkin, J. B., M. A., *Principal of Normal School*, Truro.

73. Apr. 11. Gilpin, Edwin, M. E., F. G. S., Springville, Pictou.

75. Nov. 9. Kennedy, Professor, Acadia College, Wolfville.

76. Mar. 13. Kerr, James J., Amherst.

75. Jan. 11. McKay, A. H., A. M., *Principal of Academy*, Pictou.

75. Nov. 9. McKinnon, Rev. John, Hopewell, Pictou.

75. Dec. 13. McKenzie, William, Surveyor, Moncton, N. B.

65. Dec. 28. Morton, Rev. John, Trinidad.

72. Mar. 27. Moseley, E. T., M. P. P., Cape Breton.

76. Mar. 13. Patterson, Rev. George, D. D., Greenhill, Pictou.

CORRESPONDING MEMBERS.

1871. Nov. 29. Ball, Rev. E., Springhill.

68. Nov. 25. Bethune, Rev. J. S., Ontario.

66. Sep. 29. Chevalier, Edgecumbe, H M. Naval Yard, Pembroke, England.

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

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I.—Nova Scotian Geology—Superficial. By Rev. D. Honeyman, D. C. L., F. G. S., &c. *Director of the Provincial Museum.*

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

PART I.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

INFERENCES.

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

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

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

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

PART II.

TRANSPORTATION. — COURSE.

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

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

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

Exposed striated surfaces are very numerous in the Halifax peninsula. There are but few of these and unimportant, which I have not examined. With exceptional variations, the principal directions of the striae may be regarded as above. This is also their direction on the Dartmouth side, at the windmill and on the common, I would now take the chart. On it I extend the Point Pleasant lines of striation northward.

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

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

The Dartmouth lines of striation extend in the same direction.

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

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

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

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

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

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

The lines of Fletcher's and the S. 25 W. and N. 25 E. lines of Beaver Bank if produced parallel to those of Wellington strata would cut the S. 20 E. and N. 20 W. lines observed by Dr. Dawson. The striation of the two extremes, Point Pleasant and Wellington Station, when extended (S. 30 W. and N. 25 E.) have an *arc* of 55° and include the Cobequid Mountains, from near Cape Chiegnecto to Folly Lake, a distance of 65 miles.

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

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

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

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

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

2ND AGENCY.

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

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

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

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

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

(To be continued.)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Rapaveraceœ.
Sanguinaria, canadensis. L.

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

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

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

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

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

Hypericaceœ.
Hypericum. sp——

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

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

Vitaceœ.
Ampelopsis quinquefolia. Mx.

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

Polygalaceœ.
Polygala. sp———

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

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

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

Crassulaceœ.
Sedum, rhodiola. D. C.

Halorageœ.
Hippurus, vulgaris. L.

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

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

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

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

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

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

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

Lycopodiaceæ.
Lycopodium, annotinum. L.

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

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

Fungi.
No N. S. collection.

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

TABLE I.—FLORA OF NOVA SCOTIA.

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

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

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

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

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

Art. III.—Natural History and the Fisheries. By A. P. Reid, M. D., &c.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(*Read February* 14*th*, 1876.)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Equal to metallic iron, 54.36

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

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

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

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

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

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

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

The following analysis is by Dr. Thorpe of Glasgow:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(*) Canterbury, Kent, England.

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

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

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

(*) April, 1876.

SUB-ORDER. POLYPODIACEÆ.

Tribe I. *Polypodieæ.*

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

Tribe II. PTERIDEÆ.

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

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

Tribe III. ASPLENIEÆ.

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

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

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

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

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

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

Tribe V. Aspidieæ.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Tribe V. Davallieæ.

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

SUB-ORDER III. Osmundaceæ.

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

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

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

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

SUB-ORDER IV. Ophioglossaceæ.

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

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

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

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

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

Art. VI.—The Semi Daily Fluctuation of the Barometer. By Frederick Allison.

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

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

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

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

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

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

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

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

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

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

We now proceed to the more immediate matter of this evening, the double maximum and minimum of the whole atmospheric pressure, each 24 hours. But time warns that I must be brief. An observer watching the action of his barometer constantly during the day will always notice, should no irregular disturbance affect the atmosphere at his station, a steady rise, a fall, a second rise and again a gradual fall; the same movement continuing more or less while ordinary weather lasts. Beginning, say at midnight, some clear steady night, at any time of year, he will see the column decline till about 3½ a. m.; about 4 a. m. a movement upwards from this minimum begins and continues till full 9 a.m. when a maximum height is attained. In 15 or 20 minutes again the column sinks till 3½ p. m., once more to ascend till 9. p. m., when the second fall sets in; which decline continues, as said above, until after 3 o'clock next morning. This action is certain and well known. Briefly we will discuss the reasons for it; and first I think we will find at the bottom of our investigations, the great controller of our atmosphere, heat. Indeed we need go no farther than this agency for the direct cause of the second minimum and maximum of the Barometrical column. A mere superficial glance at once leads us to a correct conclusion that as the heat increases during the forenoon, after 9 o'clock the air becomes lighter, and pressure is taken off the cistern, and this will continue till after 3 p. m., when the greatest heat of the day having been reached, the gradually cooling atmosphere grows more dense and presses the mercury up the tube.

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

But the column has reached its greatest height for the present, and in a few minutes begins to descend. Why? Because in addition to the gradual cooling of the atmosphere above mentioned a force of descending vapour has been at work in the early hours of the night pushing down upon the cistern of the barometer, and greatly aiding in the elevation of the column thus doubly effected. And soon after 9 p. m. this second force ceases; the earth becoming cooled to equal the temperature of the air, or nearly so. This fact is again shewn by the deposit of dew being greatest in the early hours of the evening, between sundown and 9 p. m., when the humid vapour of the atmosphere descends most rapidly and forms in drops of visible water upon the ground and other material substances as they cool. The most energetic force then being at an end, the mercury about 9½ p. m., again gradually retires down the tube till 3 a. m., or a little after. But why should this second descent not continue, at least till the rising sun rarifies the atmosphere by heat, when the downward tendency would be accelerated, as we have seen that it is after 9 a. m.? Because as daylight approaches, and the earth is at its coldest, the expansion of the vapour, which we have noted as condensing and pushing downwards at the beginning of night, re-commences. The earth which parts with heat less readily than does the atmosphere, is also more loth to take it in, and now about 3½ in the morning (as an average hour for the twelve months) is most cold. Then the layer of atmosphere immediately on the earth's surface is the next deficient of heat, and the higher strata (I speak within limits proximate to our planet) are the warmer. So the night vapour rises, but not only does it rise, but with its "quasi explosive force," as says Sir Henry James in commenting upon Professor James Espy's interpretation of this phenomenon, it presses upon the delicate barometer and the mercury rises, till our starting point of 9 a. m. is again reached, when the atmosphere being heated and dried and the ground warmed, the fluctuation again begins its diurnal career. This motion is known to be constant in regular weather, so much so as to be spoken of as "Diurnal Atmospheric Tide"; but while proved to take place on all the continents (which it will be remembered are chiefly inhabited on their shores, or at comparatively small distances from the oceans) it becomes very obscure in the interiors of large land tracts. This is well marked in our own country. Even in Ontario these tides are not so great as here beside the sea. In Manitoba still less. And when we have got a sufficient number of observations from that district, between Winnipeg and the Rocky Mountains, I shall not be surprised to find the double fluctuation almost obliterated; and but one well defined maximum and minimum of pressure corresponding to the least and greatest heat of the day.

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

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

(*Read May 8th*, 1876.)

FAMILY-COLUBRIDÆ.

Genus—EUTÆNIA

Eutœnia Sirtalis. Baird and Girard.

Coluber Sirtalis. Linn.

GARTER SNAKE.

Genus-BASCANION.

Bascanion Constrictor. B. & G.

BLACK SNAKE.

Genus-Storeria.

Storeria occipitomaculata. B. & G.

Red Bellied Snake.

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

The Garter Snake.

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

Trophidonatus Sirtalis. Hol.
Trophidonatus tœnia. DeKay.

This snake, so common in almost all countries in the temperate zones, is found on the Island in large numbers. It seems to attain to a much greater size than in Nova Scotia. I have frequently seen them from 2½ feet to 3½ feet in length; and from 2½ inches to 5 inches in circumference at the thickest part. I think the colour too is generally darker than that of the Nova Scotia Garter Snake, although in some cases the belly is nearly white. They often resist when attacked. The largest one I have seen measured 4 feet 9 inches in length, and was 4½ inches in circumference. It was beautifully coiled up beside a decayed tree, enjoying the afternoon sun of an August day. It is believed that they receive their young in their stomachs, on the approach of danger. I have seen them with toads in their stomachs; in one instance the snake had three toads in his stomach at once, and was almost completely torpid. These snakes have frequently been seen swimming across the Hillsboro, near Charlottetown, where the river is over a mile in width. They look very pretty in the water—the head erect several inches above water, and moving about from side to side with the motion peculiar to the serpent, and the body and tail sweeping behind.

The Black Snake.

Bascanion Constrictor. B. & G.

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

THE RED BELLIED SNAKE.

Storeria Occipitomaculata. B. & G.

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

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

THE STRIPED SNAKE.

Coluber lineatus? Mellish.

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

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

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

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

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

Art. VIII.—Notes on some Nova Scotian Plants. By George Lawson, Ph. D., Ll. D., *Professor of Chemistry, Dalhousie College, Halifax.*

Calluna vulgaris.

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

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

Several other stations became known. In the first place, Mr. Murray, the Provincial Geologist, found the plant growing in Newfoundland, thus silencing the doubts that had been expressed in regard to Cormack's specimen. Then a lady in Halifax produced a specimen which she had gathered some years before, somewhere on the Dartmouth hills; and another lady searched and found where it had been gathered, and brought a fresh specimen, with the information that there was only one plant. It subsequently became known that there were several patches of Heather at a particular spot in Point Pleasant Park, and, although too much of it has

Note. I found the Scotch Heather at Louisburg Cape Breton in Sep. 1861 and at the Frenchman's Barn. Arisaig. N.S. in Aug 1863 [?]
D Honeyman [?]

already been taken away by inconsiderate persons, yet it still exists there. Numerous explanations have been offered as to how the Heather got there, most persons assuming apparently that it could not be indigenous. One suggestion was that the Highland soldiers encamped there some thirty or forty years ago, used heather brooms for sweeping out their camps, and that the seeds had dropped from the brooms, and given rise to the heather patches.

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

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

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

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

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

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

SAROTHAMNUS SCOPARIUS.

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

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

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

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

Rhododendron maximum.

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

To the Editor of the Herald:

"HONOR TO WHOM HONOR IS DUE."

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

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

Yours, &c.,

J. D. VANBUSKIRK.

Dartmouth, Jan. 5th, 1876.

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

To the Editor of the Herald:

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

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

Yours truly,

HENRY HOW.

To the Editor of the Morning Herald:—

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

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

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

Yours, &c.,

A SPADE

To the Editor of the Morning Herald:

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

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

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

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

R. Power,
Public Gardens.

To the Editor of the Morning Herald:

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

I am, Sir,
Your most obd't serv't.,
George Lawson.

Dalhousie College, Jan. 10, 1876.

Halifax, Jan. 7th, 1876.

My dear Dr. Lawson,—

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

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

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

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

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

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

HALIFAX, Jan. 8th, 1876.

MY DEAR SIR,—

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

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

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

Dr. Lawson, &c., &c.

TO PETER JACK, ESQ.,

Dear Sir,—

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

Yours very truly,

D. W. Archibald.

Sheet Harbor, 17th Jan., 1876.

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

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

ASA GRAY.

It will be observed that we have now knowledge of six stations in Nova Scotia, two in Newfoundland, two in Massachusetts, and one in Maine, making in all eleven stations on the Atlantic seaboard of North America.

G. L.

ART. IX.—A NOTE ON THE CARIBOU. BY R. MORROW.

(*Read March 13th*, 1876.)

IN Captain Hardy's "Forest Life in Acadia," page 125 is the following:

"With regard to the barren ground Caribou (*R. grœnlandicus*) "being distinct from the larger animal of the forests, the separation "of the two as species by Professor Baird, of the Smithsonian Insti- "tution at Washington, * * * * * * joined with the "opinion expressed by Sir John Richardson * * * * * * "and the further testimony of Dr. King, surgeon to Back's expedi- "tion, appears to leave no room for doubt;" and again, "Dr. King "mentions that the barren ground species is peculiar not only in "the form of its liver, but in not possessing a receptacle for bile."

Referring to the above, I would like to record in our Transactions the following note:

Our Caribou (woodland var.) has a peculiar liver, rather small, ovate, long diameter nine inches, short diameter six inches, (from an animal supposed to be about eighteen months old,) situated on the right side, long diameter nearly parallel with the back bone, divided almost in the centre by a shallow sulcus, and having a protuberance, or small somewhat conical lobe, which the butcher calls a button, upon the upper part of the concave side with a broad base, and another very small one like a flat teat,* in the same line as the large one, one and a half inches below it, in size about half an inch long, three eights of an inch wide, and about one eighth of an inch thick; and it has no gall bladder. It is more than probable that this form of liver and absence of the gall bladder is common to the deer tribe: Goldsmith says "all the deer tribe want the gall bladder."

I have never seen a barren ground Caribou, nor any description of the animal giving the peculiarity in the form of the liver of this species, so called; but the structure of the barren ground and woodland varieties of Caribou is most likely the same, and the difference in size and horns is probably due to climate and food, while the migrations in contrary directions of the two "varieties in the barren grounds" and "woodland districts" of Sir John Richardson, may be accounted for by the fact that each is taking its nearest course to the sea coast.

Our worthy President, Dr. Gilpin, in a paper read before the Institute, February 11, 1871, and published in the Transactions, says, speaking of the varieties, "Reindeer, Caribou, and Woodland Caribou, are their local names. In addition to this the extreme north possesses a deer smaller than any of those, with much larger horns, and with no gall bladder; otherwise the same. Sir John Richardson calls them a permanent variety, naming them Barren Ground Caribou. The absence of the gall bladder seems a very great divergence; yet can any one tell me has our Caribou one?" With regard to the gall bladder I know that Dr. Gilpin has been for some time aware that our Caribou does not possess one, but he has not mentioned the peculiar form of the liver, nor do I think that it has been previously noticed.

* This is not always present.

APPENDIX.

INTRODUCTION TO A SYNOPSIS OF THE FLORA OF NOVA SCOTIA.

By J. SOMMERS, M. D., *Prof. of Physiology, &c., Halifax Medical College.*

THE catalogue of Nova Scotian species presented, is published by the Institute for the purposes of affording information and opportunity for comparison to Botanists in other localities.

Without pretensions to more than a check list of native and naturalized plants so far described, it may be accepted as the most complete synopsis of the Nova Scotian Flora yet offered.

It has been compiled with care from materials supplied by several observers working independently in different sections of the Province; corrections and additions have been made previous to placing it in the hands of the publisher, and a further guarantee of its accuracy will be found in the correspondences existing between the different observers.

While claiming so much for it we are not unmindful of what the scientific Botanist will learn from a glance, viz., its imperfectness; since he cannot fail to notice that while the Penerogamia exclusive of Cyperaceæ, and Graminæ are nearly complete, the Cryptogamia, excepting Filices and Lycopodiace, are but sparingly represented, the deficiency being owing to want of application, rather than the want of material upon which to work.

It is hoped, that the success which has attended the investigations, "of the Rev. E. Ball, a member of the Institute" into the number and variety of our native ferns, will serve to stimulate those who have the requisite skill and leisure, to attempt the same for the remaining orders of this division of our Flora, nor will the labor so applied yield less gratifying results.

The subarctic character of our flora will be observed from a study of our list. Another feature deserving attention is the preexistence of ancient forms, "also characteristic of our fauna," and probably owing to our woodlands consisting largely of coniferous trees, having served as an asylum, preserving them in situ not unlikely since the recession of the glacial period which scattered their congeners and descendants over the vast expanse of the

American continent in so much that our provincial flora presents as it were an epitome of the subarctic species found in the south and west.

The presence of common heather in our flora is interesting from affording an additional link to the chain of evidence which is indicative of relationship with the flora of northern Europe. It has been affirmed that true heath, calluna vulgaris, is not indigenous to America. Prof. Asa Gray, who is universally regarded as an authority, entertains a contrary opinion, and Prof. George Lawson in a former vol. of the Society's Transactions has afforded sufficient evidence of its existence in Cape Breton and Newfoundland, to strengthen the foundations of this opinion. Later still a new locality has been found in the vicinity of Halifax. Taking these with its existence in New England, where it was first discovered, we have sufficient grounds for claiming it as a native species.

The argument against its nativity, and in favor of its being introduced is founded upon its sparcity, but it may be said of this as of other rare species,—they are the remnants of more extensive communities, which, owing to unfavorable conditions have been caused to disappear, so that their present localities may be regarded as their final strongholds in our continent.

That the circumstance of rare occurrence does not always militate against the spontaneity of a species, is exemplified in our list by the presence of the Rhododendron Maximum, whose northern limit was confined to the New England States; yet one locality here has lately yielded specimens of this plant, which up to the present time, has been discovered no where else in the Province. Amongst our ferns also we find, asplenium, trichomanes, woodsia ilvensis, and aspidium, fragrans, rare, and confined to few localities, yet we doubt not of their being indigenous.

We need but make mention of the operations of the agriculturist and lumberman in a country like ours, to have them recognized as effective causes, ever tending to change the character of our flora by producing the elimination of native, and affording favorable condition for the naturalization of foreign species. If we add to these influences the destructive fires which ravish our woodland annually, we find in them sufficient reasons for the supposition that species found, rare, and in sequestered places, are more probably native forms seeking refuge from extinction, than immigrants seeking establishment on a new soil.

'Tis true some introduced plants possess remarkable powers of spreading, and will sometimes be found in places very remote from civilization; nevertheless in the vast majority of instances these species are found only in the vicinity of human habitations, i. e. cleared lands and pastures where they have room to spread, and dispute the soil with native plants but even here they do not always obtain exclusive possession; many native plants possess such vigorous powers of reproduction that they very often compete so successfully with the immigrants as to obtain the mastery in the occupation of cleared lands, which are neglected by the husbandman.

ABBREVIATIONS USED IN THE CATALOGUE.

H.=Herbarium (Prov Museum) Prof. How, D. C. L., Kings' College, Windsor, N. S.

Ln.= " Prof. Lawson, Ph. D., L.L.D., Dalhousie Coll., Halifax, N. S.

S.= " Prof. Sommers, M. D., Halifax Medical College.

K.= " A. H. McKay, B. A., Principal Pictou Academy.

B.= " Rev. E. H. Ball, (St. Luke's) Halifax, N. S.

C.= " D. A. Campbell, M. D., C. M., Halifax Medical College.

Ly.= " A. W. H. Lindsay, M. D., Halifax, Nova Scotia.

n means near.

A CATALOGUE OF THE FLORA OF NOVA SCOTIA,

Arranged according to Gray's Manual of Botany for the N. United States of America. By A. W. H. L.

EXOGENS.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et Al.*
RANUNCULACEÆ.				
Clematis Virginiana, L.	Falmouth, H.	Bedford, Ln.	Pictou, K., Ly	Wilmot, Annap H. Whycocomah, C.B., Ly
Anemone Pennsylvanica, L.				n Truro, Colchester, C.
Hepatica triloba, Chaix.	Falmouth, H.			Bridgewater, Lunen., B.
Thalictrum Cornuti, L.	Windsor, H.	n Bedford, Ly., Ln. Halifax, S.	Pictou, K.	Str. Canso, Guysb., B.
T. Cornuti L. var?		Bedford, Ln.		
Ranunculus aquatilis, L. var. trichophyllus, Chaix.				n Truro, C.
R. multifidus, Pursh.	Windsor, H.			n Sydney Bar, C.B., H.
R. Flammula, L. var. reptans		Dartmouth, Ly. Ln. Hx S		
R. Cymbalaria, Pursh.	Avon Riv., H.	Musquodoboit River, Ly Bedford, Ly., Ln., S. Sable Island	Pictou, K.	
R. abortious, L.			Pictou, K.	n Truro, C.
R. recurvatus, Poir.			Pictou, K.	
R. Pennsylvanicus, L.			Pictou, K.	
R. repens, L.		Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, B.
R. acris, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, B.
Caltha palustris, L.				Mahone Bay, B
Coptis trifolia, Salisb.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Manchester, Guysb., B.
Aquilegia Canadensis, L.		N. W. Arm, Halifax, S.		
A. vulgarus, L. (garden escape)		n Princes Lodge, Ln., Ly.	n Pictou, K.	
Actæa spicata, L. var. rubra Michx.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	Str. Canso, Guysb., B. Truro, Colchester, C.
A. alba, Bigel.	n Windsor, H.		n Pictou, K.	Strait Canso, B., Truro, C.

NYMPHÆACEÆ.				
Brasenia peltata, Pursh.		Rocky Lake, Ln. Ly.		
Nymphæa odorata, Ait.		n Halifax, Ln., S., Ly.	Pictou, K.	
Nuphar advena, Ait.		Halifax, Ln., Ly. S.,	Pictou, K.	Cape Breton, H.
SARRACENIACEÆ.				
Sarracenia purpurea, L.	n Windsor, H.	Halifax, Ln. S. Ly.	Pictou, K.	Cape Breton, H. Mahone Bay, B.
PAPAVERACEÆ.				
Papaver somniferum, L.		n dwellings, Ln. in some places escaped.		
Sanguinaria Canadensis, L.			Pictou, K.	n Truro, C. Ly.
FUMARIACEAE.				
Diceutra Canadensis, D.C.				n Truro, C. Ly.
D. Cucullaria, D.C.			Pictou, K.	
Corydalis glauca, Pursh.	Windsor, H.	N.W. Arm, Halifax, S. Ly		
CRUCIFERÆ.				
Nasturtium officinale, R. Br.	Bet. Wind. & Newpt. H			Truro, C.
Cardamine rhomboidea, D. C.			Picton, K.	n Truro, C. Ly.
C. hirsuta, L.	n Windsor, H.		Pictou, K.	
Barbarea vulgaris, R. Br.		n 4 mile Ho., Halifax, Ln	Pictou, K.	
Sisymbrium officinale, Scop.			Pictou, K.	
Sinapis nigra, L.		Halifax, Ly.		Parrsboro, Cumb., H.
Lepidium intermedium, Gray.			Pictou, K.	
L. ruderale, L.	Windsor, H.			Sydney Bar, C. B., H.
Capsella Bursa-pastoris, M.	Introd.	near dwellings. Halifax, Ln., Ly., S.	Pictou, K.	Introd.

	Hants.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
CRUCIFERÆ.				
Cakile Americana, Nutt.		Halifax, S.	Pictou, K., Ly.	Oyster Pond, Guysb., B.
Raphanus Raphauistrum, L.				Annapolis, K.
Dentarea diphylla, L.			Pictou, K.	
VIOLACEÆ.				
Viola rotundifolia, Michx.	Teny, Cape H.			
V. lanceolata, L.		n Halifax, Ly., Ln., S.		Annapolis, K.
V. blanda, Willd.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Truro, C.
V. cucullata, Ait.	n Windsor, H.	Halifax, Ln , S. Ly., Musquodoboit, Ly.	Pictou, K.	Truro, C.
V. sagittata, Ait.		n Halifax, Ly., S.		
V. ovata, Nutt.		N. W. A., Halifax, Ly. Pt. Pleasant, " Ln.		
V. pubescens, Ait.			Pictou, K.	n Truro, C. Ly., Strait Canso, B.
V. tricolor, L.		Rocky Lake, Ln.		
V. odorata, L.			Gard, esc. K.	
CISTACEÆ.				
Hudsonia ericoides, L.		McNab's Isd., H. S.		
H. tomentosa, Nutt.		N. W. Arm, Halifax, S.		
DROSERACEÆ.				
Drosera rotundifolia, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Oyster Ponds, Guysb., B.
D. longifolia, L.		Halifax, Ln., S. Ly.		
HYPERICACEÆ.				
Hypericum perforatum, L.	Windsor, H.	Halifax, S.	Pictou, K.	

HYPERICACEÆ.				
H. corymbosum, Muhl.		Halifax, Ln., Ly.		
H. ellipticum, Hook.				Wilmot, Annap., H.
H. mutilum, L.	Windsor, H.	Dartmouth, Ly.		
H. Canadense, L.	Windsor, H.	Halifax, Ly. S.		
Elodes Virginica, Nutt.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
CARYOPHYLLACEÆ.		12 M. Ho., W. Road, Ln.		
Saponaria officinalis, L.				
Silene noctiflora, L.		Aweed, Lucyfield, Ln.		
Lychnis vespertina, Sibth.				Annnapolis, K.
L. Githago, Lam., (introd.)		Halifax, S.	Pictou, K.	Str. Causo, Guysb., B.
L. dioica, L., (introd.)				Kentville, Ln.
Arenaria serpyllifolia, L.		Halifax, Ln.		
A. lateriflora, L.	n Windsor, H.	{ Cow Bay, Halifax, Ly., n. Halifax, S.	Pictou, K	
Stellaria media, Smith, (intro.)	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
S. longifolia, Muhl.				Margaretville, H.
S. longipes, Goldie.		Halifax, Ln., Ly.		
Cerastiumvulgatum, L.		Halifax, Ly., Ln. S.	Pictou, K.	
C. viscosum, L.		Halifax, S. Ly.	Pictou, K.	
C. nutans, Raf.		Win. Junction, Ln., Ly.		
C. arvense, L.			Pictou, K.	
Sagina procumbens, L.		Bedford, Ln., Ly.	(Pictou, K. ?)	
S. nodosa, Fenzl.		Halifax, S.	Pictou, K.	
Spergularia rubra, Presl. var. campestris. }	Windsor, H.	Halifax, Ln., Ly. S.	Pictou, K.	
Var. Marina.		Pennant, S.		
S. media, Presl.			Pictou, K.	
Spergula arvensis, L., (intro.)	Windsor, H.	Halifax, S.	Pictou, K.	
Honkenya peploides, D. C.		Pennant, S.		

	Hants.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
PORTULACACEÆ.				
Portulaca oleracea, L.				Com. in Cornwallis, Ln.
Claytonia Virginica, L.			Pictou, K.	n Truro, C. Ly.
C. Caroliniana, Michx.			Pictou, K.	Hall's Harb., Kings' Co. Sherbrooke, Guysb., H. Port Mulgrave, B.
MALVACEÆ.				
Malva rotundifolia, L.	Windsor, H.			Kentville, H.
M. moschata, L.			Pictou, K.	C. Bretn, H, Mr Poole coll
M. borealis, Wallm.		Sackville, Ln.		
TILIACEÆ.				
Tilia Europaæ.		Planted, Halifax, Ln.		
LINACEÆ.				
Linum usitatissimum, L.		In cultivated ground, Halifax, Ln.		
GERANIACEÆ.				
Geranium maculatum, L.	Windsor, H.	In fields, Halifax, Ly.		
G. Carolinianum, L.		Elmsdale, K.		
G. Robertianum, L.	n Windsor, H.		Pictou, K., Ly	Manchester, Guysb., B., Whycocomah, C.B., Ly.
Impatiens fulva, Nutt.	Windsor, H.	Halifax, S. Ln. Ly.	Pictou, K.	Whycocomah, C.B., Ly. Oyster Ponds, Guys., B.
Oxalis Acetosella, L.		Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
O. stricta, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.

ANACARDIACEÆ.				
Rhus typhina, L.	cultivated, Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
R. Toxicodendron, L.		Bedford Basin, Ln., Ly.		Cumberland, K., Whycocomah, C.B., Ln.
R. glabra, L.		n Chain Lakes, S.		
VITACEÆ.				
Vitis cordifolia, Michx.				Annapolis? Ln.
Ampelopsis quinquefolia, Micx.		Cultivated, Ln.		
SAPINDACEÆ.				
A. Esculus Hippocastanum, L.		Commonly planted, Ly.	P anted, K.	Annapolis, K.
Acer. Pennsylvanicum, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
Acer. spicatum, Lam.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
A. saccharinum, Wang.	Windsor, H.	Halifax, Ly.	Pictou, K.	Cape Breton, Ly.
A. rubrum, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
POLYGALACEÆ.				
Polygala polygama, Walt.		Dutch Village, S.		
LEGUMINOSÆ.				
Cytisus Scoparius, Link.				naturalized, Shelburne, (Mr. P. Jack, coll.)
Trifolium arvense, L.		Halifax ? Ln.		
T. pratense, L., introd.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, B.
T. hybridum, L.		Fields and pastures, Lucyfield, Ln.		
T. repens, L.		Halifax, Ly., Ln.	Pictou, K.	Str. Canso, B.
T. agrarium, L., introd.		Fields, Bedford, Ly.		(Sydney, C.B., K)?

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
LEGUMINOSÆ.				
T. procumbens, L., intr.	Windsor, H.			
Melilotus officinalis, Willd.	Windsor, H.	N. W. Arm, S.	Introd.	
M. alba, Lam., intro.		{ Bellahill farm, Sackville, Ln.		
Medicago lupulina, L., intro.	Windsor, H.	Halifax, Ln. S.	Pictou, K.	
Robinia Pseudacacia, L.	Windsor, H.		Pictou, K.	
R. Viscosa, Vent.	Windsor, H.			
Vicia sativa, L., intro.		Elmsdale, K.		Parrsboro'—indig ? H.
V. tetrasperma, L.	Windsor, H.	Halifax, S.		
V. sativa, L.		n Halifax, S., intro.		
V. cracca, L.		{ n Halifax, Ly. S., Hammonds Plains, Ln.		
Lathyrus maritimus, Bigelow.		Bedford, Ln., Ly., S.	Pictou, K., Ly.	
L. palustris, L.	Windsor, H.		Pictou, K.	
Apios tuberosa, Mœnch.			W. River, Ly.	
ROSACEÆ.				
Prunus Pennsylvanica, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. Virginiana, L.	Falmouth, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. serotina, Ehrhart.		N. W. Arm, Hx., Ly., S.		
Spiræa salicifolia, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
S. tomentosa, L.	Windsor, H.	Halifax, Ly., S., Ln.	Pictou, K.	
Agrimonia Eupatoria, L.	Windsor, H.		Pictou, K., Ly	Truro, C.
Alchemilla arvensis, L.		Lucyfield, Ln.		St. Paul's, C.B., K.
Poterium canadense.				
Geum album, Gmelin.	Windsor, H.			Truro, C.
G. Virginianum, L.			Pictou, K.	
G. macrophyllum, Willd.				{ Middletown, Guysb., B., n Truro, C., Ly.

ROSACEÆ.				
G. rivale, L.	Windsor, H.	Dartmouth, Ly.	Pictou, K.	Str. Canso, Guys., & near Lunenburg, } B.
Strictum.	Windsor, H.			
Potentilla Norvegica, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Kentville, Kings Co., & Whycocomah, C B } Ly
P. Canadensis, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. argentea, L.	Windsor, H.			{ n Truro, C. Margaretville, H. Kentville, Ly.
P. anserina, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Bear River, Digby, H.
P. tridentata, Ait.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. tormentilla.				St. Ann's, C.B., Ln.
P. palustris, Scop.		C. Bay, Dartmouth, Ly.		C. B., K.
P. Fruticosa, L.	Windsor, H.			
Fragaria Virginiana, Ehrhart.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Cape Breton, Ly.
F. vesca, L., intro.	Windsor, H.	Halifax, Ln.		
Dalibarda repens, L.		(n Halifax, Ly ?)	Pictou, K.	{ Wilmot, Annap., H., Bloomfield, Digby, B.
Rubus odoratus, L.				{ Manchester, Guysb., B., cult'ed at Annaps., pos'bly fm. w plants } Ln
R. Chamæmorus, L.		Halifax, Ly., S.		{ Cape Breton, H , (Mr. Poole, coll.)
R. triflorus, Richardson,	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	
Rubus strigosus, Michx.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Cape Breton, Ly.
R. villosus, Ait.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
R. Canadensis, L.		Halifax, Ln., Ly., S.	Pictou, K.	
R. flacidus,		Great Beaver Bank, Ln.		
R. hispidus, L.		Halifax, S.	Pictou, K.	

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
ROSACEÆ.				
Rosa Carolina, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
R. lucida, Ehrhart.		Halifax, Ly.	Pictou, K.	Cape Breton, H., (Mr. H. Poole, coll.)
R. blanda, Ait.		Halifax, Ly.	Pictou, K.	
R. rubiginosa, L.		n Bedford, Ln., Old Windsor Road.		Cumberland, K.
Cratægus Oxyacantha, L.		Halifax, Ln., Ly.		
C. coccinea, L.	Windsor, H.	Halifax, S.	Pictou, K.	
Pyrus arbutifolia, L.	Windsor, H.			
Var Erythrocarpa,		Bedford, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
Var melanocarpa.		Rocky Lake, Ly.		
P. Americana, D. C.	cultivated, Windsor, H.	Halifax, Ln., Ly , S.	Pictou, K.	
P. sambucifolia, Cham. & Sch.			Pictou, K.	
Amelanchier Canadensis, Torr. & Gr.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
A. Canadensis, var oblongifolia	Windsor, H.			
SAXIFRAGACEÆ.				
Ribes hirtellum, Michx.		Halifax, Ly., S.	Pictou, K.	
R. rotundifolium, Michx.	R. Avon, H. Windsor.	Halifax, S.	Pictou, K.	
R. lacustre, Poir.	R Avon, H. Windsor.		Pictou, K.	
R. prostratum, L'Her.		Halifax, S., Ly.	Pictou, K.	
R. floridum, L.	n Brooklyn, H			
R. rubrum, L.	R. Avon, H. Windsor.			

Saxifragaceæ.				
R. aureum, Pursh.			Cultivated, K.	
R. nigrum, L.	Garden escape, H.			
Mitella nuda., L.	Windsor, H.		Pictou, K.	
Tiarella cordifolia, L.			Pictou, K.	n Truro, C., Ly.
Chrysosplenium Americanum, Schwein.				Tatamagouche, K.
Crassulaceæ.				
Sedum acre, L.		n Bedford, Ln., Ly., Dutchville, S., introd.		
S. Telephium, L.			Garden es, Ly.	
S. Rhodiola, D. C.				Cape Breton? Ln.
Hamamelaceæ.				
Hamamelis Virginica, L.		n Halifax, Ln., S., Ly.	Pictou, K.	
Haloraceæ.				
Hippuris Vulgaris, L.		Dartmouth and Cow Bay, Ly.		
Onagraceæ.				
Circæa Lutetiana, L.			Pictou, K., Ly	
C. alpina, L.	Windsor, H.	Pennant, Hx., S., Cow Bay, Ly.	Pictou, K.	Str. Canso, Guysb., B.
Epilobium angustifolium, L.	Windsor, H.	Halifax, S., Ln., Ly.	Pictou, K.	
E. palustre, L., var. lineare,	Windsor, H.		Pictou, K.	
Var. albiflorum, intro.		Pennant, S.		
E. molle, Torr.				n Truro, Ly.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
ONAGRACEÆ.				
E. coloratum, Muhl.	Windsor, H.	Dutchville, S.	Pictou, K.	Parrsboro', H.
Œnothera biennis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K., Ly	
Œ. fruticosa, L.		Lucyfield, Ln.; Grand Lake, S.	Pictou, Ly.	
Œ. chrysantha, Michx.	Windsor, H.	N. W. Arm, Halifax, Ly.		
Œ. pumila, L.	Windsor, H.	Halifax, S.	(Pictou, K ?)	Str. Canso, Guysb., B.
Ludwigia palustris, Ell.				Wilmot, Annap., H.
CUCURBITACEÆ.				
Echinocystis lobata, Torr. & Gr.		Dartmouth, Ln.		
UMBELLIFERÆ.				
Hydrocotyle Americana, L.		n 3 Mile House, Halifax, Ln., Ly.		
Sanicula Marilandica, L.	n Windsor, H.			Truro, C.
S. canadenses, L.				Cape Breton, K.
Heracleum lanatum, Michx.			Pictou, K.	Margaretville, H.
Ligusticum Scoticum, L.		Halifax, Ln., S., Ly., int.	Pictou, K.	
L. actæifolium, Michx.				Parrsboro', H.
Cicuta maculata, L.		Halifax, Ln., S., Ly.	Pictou, K.	Truro, C.
C. bulbifera, L.			Pictou, K.	
Sium lineare, Michx.		Halifax, Ln., S.	Pictou, K.	Truro, C.; Wilmot, Annap., H.
S. latifolium, L.	Windsor, H.	Pennant, S.		
Osmorrhiza brevistylis, D.C.				East Mt. Onslow, C.; Kentville, Kings, Marble Mt., C.B. } H.
Carum Carui, L.		An escape, Ln., Ly.	Truro, C.	Truro, C.

UMBELLIFERÆ.				
Authriscus vulgaris, Pers.		introduced n Bedford, Ly.		
ARALIACEÆ.				
Aralia racemosa, L.		n Halifax, H.		
A. hispida, Minchx.	Windsor, H.	Halifax, S.	Pictou, K.	n S. River, Colch., Ly., Str. Canso, Guysb., B.
A. nudicaulis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, B.
A. trifolia,		Cow Bay, Halifax, Ly.	n Dalhousie, K	n Truro, C.
CORNACEÆ.				
Cornus Canadensis, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.
C. circinata, L'Her.	n Windsor, H.			
C. stolonifera, Michx.	n Windsor, H.			
C. paniculata, L'Her.		Halifax, Ln., Ly.		
C. alternifolia, L.		Halifax, S.	Pictou, K.	
CAPRIFOLIACEÆ.				
Linnæa borealis, Gronov.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Guysboro' B. Cape Breton, Ly.
Symphoricarpus racemosus, Michx.			Pictou, K.	
Lonicera ciliata, Muhl.	Windsor, H.	n Halifax, S.	Pictou, K.	n Truro, C., Ly.
L. cærulea, L.		Pt. Pleasant, S., Ly., Oldham, K.		
Diervilla trifida, Mœnch.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
Sambucus Canadensis, L.	Windsor, H.	Bedford, Ln., n Halifax, S., Ly.	Pictou, K.	
S. pubens, Michx.		Halifax, Ly., S.	Pictou, K.	
Viburnum nudum, L.	Windsor, H.		Pictou, K.	

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
CAPRIFOLIACEÆ.				
Viburnum Lentago, L.		Halifax, S.		
V. accrifolium, L.				Horton Mt., Kings, H.
V. Opulus, L.		n Halifax, S.	Pictou, K.	
V. lantanoides,	Windsor, H.	Halifax, S.	Pictou, K.	n Truro, C., Ly.
RUBIACEÆ.				
Galium asprellum, Michx.	Windsor, H.			Canso, B., intro.
G. trifidum, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
G. triflorum, Michx.	Windsor, H.	Halifax, Ly., S.	Pictou, K.	
Sherardia arvensis, L.				Tatamagouche, Colch., K.
Mitchella, repens, L.	Windsor, H.	Halifax, Ly., Ln., S.	Pictou, K.	
Houstonia cærulea,		Halifax, Ln., H., S., Ly.		
COMPOSITÆ.				
Eupatorium purpureum, L.	Windsor, H.	{ Bedford, S., Ln., Ly. { Pennant River, S.	Pictou, K., Ly	Truro, C.
E. purpureum, L., Var?	Windsor, H.			
E. perfoliatum, L.	Windsor, H.	{ Beaver Bank, Ln., { Bedford, S., { Dutchville, S.	Pictou, K., Ly	
Nardosmia palmata, Hook.				Isle Madame, C.B., B.
Aster macrophyllus, L.	Windsor, H.			
A. lævis, L.		Halifax, S.		
A. cordifolius, L.			Pictou, K.	
A. Tradescanti, L.			(Pictou, K?)	
A. miser, L.		Halifax, S.		
A. simplex, Willd.	(Windsor, H?)	alifax, S.	Pictou, K.	
A. carneus, Noes.	(Windsor, H ?)			
A. longifolius, Lam.	Windsor, H.	Halifax, Ly., S.		

COMPOSIEÆ.				
A. puniceus, L.	Windsor, H.			
Var vimineus,		n Halifax, S.		
A. acuminatus, Michx.	Windsor, H.	Halifax, S.		
A. nemoralis. Ait.		Halifax, S.		
Erigeron Canadense, L.	Windsor, H.	Halifax, Ly., S.		
E. bellidifolium, Muhl.		Halifax, S.		
E. annuum, Pers.	Windsor, H.		Pictou, Ly.	
E. strigosum. Muhl.	Windsor, H.			
Solidago bicolor, L.			Pictou, K.	
S. bicolor, L., var. concolor,			Pictou, K.	
S. latifolia, L.	Windsor, H.	Halifax, S.		Str. Canso, B.
S. cæsia, L.		Halifax, S.		
S. Virga-aurea, L.	Windsor, H.	Halifax, S., Ly.		
Var ?	Windsor, H.			
Var ?	Windsor, H.			
S. sempervirens,		n Halifax, H.	Pictou, K.	
S. stricta, Ait.		Dutchville, S.		
S. altissima, L.		Halifax, S., Ly.		
S. Canadensis, L.	Windsor, H.	Halifax, Ly., S.		Str. Canso, Guysb., B.
S. serotina, Ait.	Windsor, H.			
S. gigantea, Ait.		Grand Lake, S.	Pictou, K.	
S. lanceolata, L.	Windsor, H.	Halifax, S.	Pictou, K.	Str. Canso, Guysb., B.
S. odora, Ait.		n Grand Lake, S.		
Inula Helenium, L.	Rawdon, B.			Horton, Kings, & Wilmot, Annap. } H.
Ambrosia artemisiæfolia, L.	Windsor, H.	Halifax, S.	Pictou, K., Ly	
Xanthium strumarium, L.			Pictou, K., Ly.	
Rudbeckia hirta, L.				Tatamagouche, K.
Helianthus annuus, L.			Ab. dwel'gs. K	

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
COMPOSITÆ.				
Helianthus tuberosus, L.		An escape, Ln.		
Coreopsis discoidéa, Torr. & Gray., (Sp. ?)			Pictou, K.	
Bidens frondosa, L.	Windsor, H.		Pictou, K.	
B. connata, Muhl.	Windsor, H.		Pictou, K.	
B. cernua, L.	Windsor, H.	Halifax, Ly.		
B. chrysanthemoides, L.		Halifax, S.		
Maruta Cotula, D. C.	Windsor, H.	Halifax, S., Ly.		
Anthemis arvensis, L.		Halifax, S.		
Achillea Millefolium, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.
Leucanthemum vulgare, Lam.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.
Matricaria inodora, L.			Pictou, K.	
Tanacetum vulgare, L.		Halifax, Ln., Ly., S.		Kentville, H.
Artemisia caudata, Michx.			Pictou, K.	
A. vulgaris, L.				Annapolis, Ln.
A. biennis, Willd.	Windsor, H.			
A. Absinthium, L.			Pictou, K.	5 Islds., Cumb., H.
Gnaphalium decurrens, Ives.	Windsor, H.			
G. uliginosum, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
Antennaria margaritacea, R. Brown,	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Wilmot, Annap., H., Canso, Guysb., B.
A. plantaginifolia, Hook.		Halifax, Ln., S., Ly.	Pictou, K.	
Erechthites hieracifolia, Raf.	Windsor, H.		Pictou, K.	
Cacalia suaveolens, L.	Windsor, H.			
Senecio vulgaris, L.		Dartmouth, Ly., Dutchville, S.	Pictou, K.	
S. palustris, Hook.				Mahone Bay, Lunenb., B.
S. aureus, L.		Halifax, S., Ly.		

COMPOSITÆ.				
Var. Balsamitæ.		Halifax, S.		
Var. lanceolatus, Oakes.	Windsor, H.			
Var. obovatus,		Halifax, S.		
S. viscosus, L.		Windsor Junction, Ln., Ly	Pictou, Ly., K.	
S. Jacobæa, L.			Pic. Ln Ly. K.,	n Whycocomah, C.B., Ly.
Centaurea nigra, L.		n Halifax, Ln.. Ly., S.	Pictou, K.	Port Mulgrave, Guys., B.
Cirsium lauceolatum, Scop.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Canso, Guysb., B.
C. arvense, Scop.			Pictou, K.	
C. muticum, Michx.			Pictou, K.	
Onopordon acanthium, L.			Pictou, K.	
Lappa officinalis, Allioni.			Pictou, K.	
Var. major.		Halifax, S.	Pictou, Ly.	
Var. minor.			Pictou, K.	
Cichorium Intybus, L.		Halifax ? Ln.		
Leontodon autumnale, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Bayfield, Antig., B.
Hieracium scabrum, Michx.	Windsor, H.	Halifax, S.	Pictou, K.. Ly	
H. Canadense, Michx.		Halifax, S.		
Nabalus albus, Hook.		Halifax, S., Ly.	Pictou, K.	
N. altissimus, Hook.	Windsor, H.			
N. Fraseri, D. C.	Windsor, H.			
Taraxacum Dens-leonis, intro.		Halifax, Ln., Ly,, S.	Pictou, K.	Common everywhere.
Lactuca elongata, Muhl.	Windsor, H.	Halifax, S.		
Mulgedium leucophæum, D. C.			Pictou, K.	
M. pulchellum, Nutt.			Pictou, K.	
Sonchus asper, Vill.	Windsor, H.	Halifax, Ln., Ly,. S.	Pictou, K.	
S. oleraceus, L.		Pennant, S.		
LOBELIACEÆ.				
Lobelia inflata, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Truro, Colch., and Whycocomah, } Ly?

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
LOBELIACEÆ.				
L. Dortmanna, L.		n Halifax, Ln., Ly., S.		Mahone Bay, Lun., B.
CAMPANULACEÆ.				
Campanula rotundifolia, L.		n Bedford, Ln.	Pictou, K.	Parrsboro', Cum., H., Truro, Col., Ly., C.,
ERICACEÆ.				
Gaylussacia dumosa, Tr. & Gry.		N. W. Arm, Halifax, Ly. S		
G. resinosa, Torr. & Gray.		Halifax, Ly., Ln., S.	Pictou, K.	Mahone Bay, Lun , B. Kentville, Kings, H.
Vaccinium Oxycoccus, L.		n Halifax, Ln., S.	Pictou, K.	Cape Breton, H.
V. macrocarpon, Ait.		Halifax, Ln., S., Ly.	Pictou, K.	Parrsboro, Cumb., H.
V. Vitis–Idæa, L.		n Halifax, Ln., H., S., Ly.		Mahone Bay, Lunen., B.
V. Pennsylvanicum, Lam.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
V. Canadense, Kalm.			Pictou, K.	
V. vacillans, Solander.		Halifax? S.		
V. corymbosum, L.		Halifax, Ln.		
Chiogenes hispidula, Tr. & Gr.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Cape Breton, Ln.
Arctostaphylos Uva-ursi, Sprg.		near Rockhead, S.	Pictou, K.	
Calluna vulgaris, Salisb.		Pt. Pleasant, Halifax Harb., Ln. Ly.		Str. Canso and South side Bras d'or., Cape Breton. Ln *also at Louisburg C B & Arisaig* [illegible]
Epigæa repens, L.	Windsor, H.	Hifaax, Ln., S. Ly.	Pictou, K.	
Gaultheria procumbens, L.	Windsor, H.	Halifax, Ln., Ly., S.		Guysborough, B.
Cassandra calyculata, Don.	Windsor, H.	Elmsdale, K., Halifax, Ln., Ly., S.		
Andromeda polifolia, L.				Cape Breton, H.
Kalmia angustifolia, L.	Falmouth, H	Halifax, Ln., S., Ly.	Pictou, K.	

ERICACEÆ.				
K. glauca, Ait.		Halifax, Ln., Ly., S.		Colchester, Kings Mahone Bay.
Rhododendron Maximum, L.		n Beaver Dam Gold Mines, Sht. Harb., Ln. Mr. Archibald, coll.		
Rhodora Canadensis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Var. (white flowers.)		Col. Hardey, coll.		
Ledum latifolium, Ait.	Falmouth, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
Pyrola rotundifolia, L.		Bedford, Ly., Halifax, S.	Pictou, K.	Wilmot, Annap H. Canso, Guysb., B.
P. elliptica, Nutt.	Windsor, H.	Halifax, S. Ln. Ly.	(Pictou, K ?)	
P. secunda, L.	Windsor, H.	C. Bay, Dartmouth, & N. W. A., Hx., Ly., S.	Pictou, K.	Whycocomah, C.B., Ly Oyster Ponds, Guys., B.
Moneses uniflora.	Windsor, H.	Cow Bay, Ly., Halifax, Ln., S., Ly.	Pictou, K.	Wilmot, Annap., H.
Chimaphila umbellata, Nutt.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	n Salmon R., Col., Ly.
Monotropa uniflora, L.		Halifax, Ly., S.	Pictou, K.	Wilmot, Annap., H., Oyster Ponds, Guys., B
M. Hypopitys, L.			Pictou, K.	
AQUIFOLIACEÆ.				
Ilex opaca, Ait.		(Sheet Harbor, Ln?)		
I. verticillata, Gray.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Cape Breton, Ly.
I. glabra, Gray.		Halifax, S.		
Nemopanthes Canadensis, D.C.		Halifax, S. Ly.	Pictou, K.	
PLANTAGINACEÆ.				
Plantago major, L.		Halifax, Ly.	Pictou, K.	
P. maritima, L.	Windsor, H.	Halifax, Ln., S.	Pictou, K.	
Var. Juncoides.		Halifax, S.		

	Hants.	*Halifax Co.*	*Pictou Co:*	*Halifax Co.*
PLANTAGINACEÆ.				
P. lanceolata.		Lucyfield; Ln.		
PLUMBAGINACEÆ.				
Statice Limonium, L.	River Avon Windsor, H	Halifax harb., Ln., S. Ly.	Pictou, K.	
PRIMULACEÆ.				
Primula farinosa, L.				n Annapolis, K., Hall's Harb, Kings, H.
P. Mistassinica. Michx.				n Truro, C.
Trientalis Americana, Pursh.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K., Ly	Port Mulgrave, Guysb, B.
T. Europæa, L.		Halifax ? Ln.		
Lysimachia stricta, Ait.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
L. ciliata, L.		Elmsdale, K.		Wilmot, Annap., H.
L. thyrsiflora.			Pictou, K.	n Truro, Col. C., Ly.
Glaux maritima, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
Anagallis arvensis, L.				Digby, H.
LENTIBULACEÆ.				
Utricularia vulgaris, L.		C. Bay, Dartmouth, Ly.		
U. cornuta, Michx.		n Bedford, Ly., S., Ln.		Lunenburg, B.
U. (sp. ?)		Dartmouth, Ly.		
OROBANCHACEÆ.				
Epiphegus Virginiana, Bart.		n Bedford, Ln.	n Bedford, Ln.	
SCROPHULARIACEÆ.				
Verbascum Thapsus, L.	Falmouth, H.	n Halifax, Ln., S. Ly.	Pictou, K., Ly	

SCROPHULARIACEÆ.				
Linaria Canadensis, Spreng.		Halifax, H.		
L. vulgaris, Mill.		Halifax, Ly., Ln.	Pictou, K.	Mahone Bay, Lun, B., Keutville, Kings, H.
Chelone glabra, L.	Windsor, H.	Halifax, S., Ln., Ly.	n Pictou, K.	Truro, C. Str. Canso, B.
Mimulus ringens, L.	Windsor, H.		Pictou, K.	Truro, C., Ly.
Veronica Anagallis, L.		Dartmouth, Ly.	Pictou, K.	
V. Americana, Schweinitz,	Windsor, H.		Pictou, K.	Mahone Bay, Lun, B., Kentville, Kings, H.
Var. Officinalis.		Halifax, S.		
V. scutellata, L.	Windsor, H.	Halifax, S.	Pictou, K.	
V. chamædrys, L.	Windsor, H.	Halifax, Ln., Ly.		
V. serpyllifolia, L.	Windsor, H.	Halifax, Ln , S., Ly.	Pictou, K.	
V. agrestis, L.	Windsor, H.			
Euphrasia officinalis, L.		Halifax, Ln., S. Ly.	Pictou, K.	Sydney Bar, C. B., H.
E. Odontites, L.	n Windsor, H.		Pictou, K.	Whycocomah, C.B., Ly.
Rhinanthus Crista-galli, L.		Halifax, Ly., S., Ln, intro	Pictou, K.	Oyster Ponds, Guys, B.
Pedicularis Canadensis.		Halifax, Ly., Ln., S.		
Melampyrum Americanum, Mx	Windsor, H.	Halifax, Ln., Ly., S.,	Pictou, K., Ly	Str. Canso, B. Truro, Col,. C.
VERBENACEÆ.				
Verbena hastata.	Windsor, H.		W. River, Ly.	Whycocomah, Ly., Truro, C.
LABIATÆ.				
Teucrium Canadense, L.			W. River, Ly.	
Mentha viridis.		Halifax, S.		
M. piperita, L.		Halifax, S., intro.	Pictou, K.	
M. aquatica, L.				n Truro, Ly.
M. sativa, L.			Pictou, K.	
M. Canadensis, L.	Windsor, H.	Halifax, S.	Pictou, K. Ly.	Colchester, Ly.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
LABIATÆ.				
Lycopus Europæus, L.	Windsor, H.	Halifax, S.	Pictou, K.	n Truro, C. Ly.
L. Virginicus, L.	Windsor, H.	Halifax, S.	Pictou, K.	
Calamintha Clinopodium, Bth.			Pictou, K.	
Hedeoma pulegioides, Pers.			Pictou, K.	
Nepeta Cataria, L.			Pictou, K.	
N. Glechoma, Benth.		Halifax, Ly., S. intro,		
Physostegia Virginiana, Benth.			Pictou, K?	
Brunella vulgaris, L.	Windsor, H.	Halifax, Ln., Ly., S. intr	Pictou, K.	Str. Canso, B.
Scutellaria parvula, Michx.		Halifax, S.		
S. galericulata, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
S. lateriflora, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
Galeopsis Tetrahit, L.	Windsor, H.	Halifax, S., Ly., intro.	Pictou, K.	Str. Canso, Guysb., B.
Stachys palustris, L.		Halifax, S.		
Leonurus cardiaca, L.			Pictou, K.	
BORRAGINACEÆ.				
Echium vulgare, L.			n N. Glas., H.	
Mertensia maritima, Don.		Halifax, Ln., Ly.		Parrsboro', Cumb., L.
Myosotis palustris,	Windsor, H.	Halifax, Ln., Ly., S.		
Var. laxa.	Windsor, H.			
Myosotis cæspitosa, Schultz,		n Halifax, Ln., Ly.	Pictou, K.	
M. arvensis, Hoffm.				Parrsboro', Cum., H., intr
Cynoglossum (sp ?)			Pictou, K.	
Borrago officinalis, L.		{ A garden escape in some places, Ly.		
CONVOLVULACEÆ.				
Ipomæa purpurea, Lam.			n dwellings, H	

CONVOLVULACEÆ.				
Convolvulus arvensis, L.			Pictou, K.	
Calystegia sepuim, R. Br.		n Halifax, Ln., Ly. S.,	Pictou, K.	Parrsboro', Cum., H.
C. spithamaeus, Br.		Pennant, S.		
SOLANACEAÆ.				
Solanum nigrum, L.		Pt. Pleasant, H., McNab's Island, Ly.		
S. Dulcamara, L.		Hx. Willow Park, S., not climbing, introd.		
Lycopersicum esculentum, Mil.		spontaneous in one or two places, S., Ly.		
Hyoscyamus niger, L.		A garden escape, S.		
Datura Stramonium, L.				escaped from gardens, Mahone Bay, B.
GENTIANACEÆ.				
Menyanthes trifoliata, L.		Halifax? Ln.		
APOCYNACEÆ.				
Apocynum androsæmifolium, L	Windsor ,H.		Pictou, K.	Colchester, Co., C.
A. cannabinum, L.	Windsor, H.		W. River, Ly.	
OLEACEÆ.				
Fraxinus Americana, L.	Windsor, H.	Halifax, S.		
F. sambucifolia, Lam.	Windsor, H.		Pictou, K.	
F. pubescens, Lam.		Halifax, Ln.		
CHENOPODIACEÆ.				
Chenopodium album, L.		A weed in gardens, Ly.	Pictou, K.	Canso, Guysb., B.
C. Botrys, L.		Sea shore Pennant, S.		

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et Al.*
CHENOPODIACEÆ.				
Atriplex patula, L.				
Var. hastata,	Windsor, H.	Halifax, S., Ly.		
A. rosea, L.		n Halifax, Ln. S. Ly.		
Salicornia herbacea, L.	R. Avon, Windsor, H	Bedford Basin, Ln., Ly. S	Pictou har, K.	
S. Virginica, L.		Halifax, S.		
Suæda maritima, Dumortier.		Bedford, Ln.	Pictou, K.	
Salsola Kali, L.		Halifax Harb., H., Cow Bay, Dart, Ly.	Pictou, K.	
POLYGONACEÆ.				
Polygonum Persicaria, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Canso, B.
P. Pennsylvanicum, L.	Windsor, H.			
P. incarnatum, Ell.				Strait Canso ? Guys., B.
P. Hydropiper, L.	Windsor, H.		Pictou, K.	Str. Canso, B.
P. aviculare, L.	Windsor, H.		Pictou, K.	Str. Canso, B.
P. maritimum, L.		Halifax, S.		
P. arifolium, L.		Halifax, Ly.		
P. sagittatum, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Oyster Pond, Guysb., B.
P. Convolvulus, L.	Windsor, H.	Halifax, S.	Pictou, K.	
P. cilinode, Michx.		Halifax, Ly., S.		
P. dumetorum, L.		Halifax, S.		
Fagopyrum esculentum, Mœnc.		escaped from fields, Ly.	Pictou, K.	Guysboro' B.
Rumex verticillatus, L.			n Pictou, K.	
R. crispus, L., intro.		Halifax, S.		
R. obtusifolius, L.		Halifax ? Ln.		
R. Viridis,		n 3 mile Ho., Halifax, Ln., Ly.		
R. acetosella, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Canso, Guysb., B.

CALLITRICHACEÆ.				
Callitriche verna, L.		Halifax, Ln.		
EUPHORBIACEÆ.				
Euphorbia Helioscopia, L.			Pictou, K.	
E. Cyparissias, L.		escaped from gardens, Ln.	Pictou, K.	
E. polygonifolia, L.			Pictou, K.	
EMPETRACEÆ.				
Empetrum nigrum, L.		n Bedford, Ly., Lucyfield, Ln., Pennant, S., Win. Junction, &c., Ln.	Pictou, K.	Sherbrooke, Guysb., H. Mr. Poole, coll.
Corema Conradii, Torrey.		n Bedford, Ly., N. W. Arm, Hx., S.		Wilmot, Annap., H.
URTICACEÆ.				
Ulmus Americana, L.	in cultiva'n. Windsor, H		Pictou, K.	
Urtica gracilis, Ait.			Picton, K.	Whycocomah, C.B., Ly.
U. dioica, L.			Pictou, K.	
U. urens, L.		n Bedford, Ln.,		Sydney, C.B., H.
Humulus Lupulus, L.			Pictou, K.	
CUPULIFERÆ.				
Quercus rubra, L.	Windsor, H.	Halifax, S. Ly.	(Pictou, K. ?)	
Fagus ferruginea, Ait.	Windsor, H.	Halifax, Ly. S.	Pictou, K.	
Corylus rostrata, Ait.		Dartmouth, S.	Pictou, K.	
Carpinus Americana, Michx.		Halifax, S.		(n Moose River, An., H ?)
MYRICACEÆ.				
Myrica Gale, L.		n. Halifax, S.	Pictou, K.	Kentville, Kings, Ly., Wilmot, Annap. and Sydney, C.B., H.

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MYRICACEÆ.				
M. cerifera, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, B.
Comptonia asplenifolia, Ait.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
BETULACEÆ.				
Betula alba, var populifolia, Sp	Windsor, H.	Halifax, Ly., S.	Pictou, K.	
B. papyracea, Ait.	Windsor, H.	Halifax, S.	Pictou, K.	
B. nigra, L.		Halifax, S.		
B. excelsa, Ait.	Windsor, H.	Halifax, Ln., S., Ly.		
B. lenta, L.			Pictou, K.	
B. lutea, Michx.			Pictou, K.	
Alnus incana, Willd.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
A. viridis, D.C.		Halifax, Ln., S.		
A. serrulata,		Halifax, S.		
SALICACEÆ.				
Salix tristis, Ait.		Halifax, S.		
S. humilis, Marshall,		Halifax, S.		
S. Muhlenbergiana,		Halifax, S.		
S. sericea, Marshall,		Halifax, S.		
S. alba, L.		Introduced, Ln.		
S. Chlorophylla, Anders.			Pictou, K.	
Populus tremuloides, Michx.		Halifax, S.	Pictou, K.	
P. balsamifera, L, var candicans		Halifax, Ln. S.	Pictou, K.	
P. dilatata, Ait.			Introduced, K.	
CONIFERÆ.				
Pinus Banksiana, Lambert.		Elmsdale, K., N. W. Arm, Hx., Ln.		

CONIFERÆ.				
P. resinosa, Ait.			Pictou, K.	
P. Strobus, L.		Halifax, S.		
Abies balsamea, Marshall,		n Halifax, S.		
A. nigra, Poir.		n Halifax, S.		
A. alba, Michx.		Pennant, S.		
A. Canadensis, Michx.		n Halifax, S.		
Larix Americana, Michx.		n Halifax, S.		
Thuja accidentalis, L.			(Pictou, K ?)	Cumberland, H.
Cupressus thyoides, L.		3 Mile House, Halifax, Lu		Cape Breton, Ln.
Juniperus communis, L.		Halifax, Ln., S., Ly.		Sydney, C.B., H.
J. Virginiana, L.				Patridge Is., Parrsboro', H
J. Sabina, L., var. procumbens,				Arisaig, H.
Taxus baccata, L., var. Canadensis,	Windsor, H.	Halifax, S.	Pictou, K.	Colchester, C.

ENDOGENS.

ARACEÆ.				
Arisæma triphyllum, Torr.	Hantsport, H.		Pictou, Ly.	Middletown, Gb., B., n Truro, Ly, Dr. Muir, col
Calla palustris, L.	Windsor, H.		Pictou, K., Ly	
Acorus Calamus,		Pennant Harb., S.		
TYPHACEÆ.				
Typha latifolia, L.		Halifax, S.	Pictou, K.	
T. angustifolia, L.		Beaver Bank, Ly.		
Sparganium eurycarpum, Eng. (Ramosum Huds,)		Halifax, S.	Pictou, K.	Oyster Ponds, Guysb., B.

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TYPHACEÆ.				
Sparganium simplex, Hudson.	Windsor, H.		Pictou, K.	
Var. augustifolium,		Halifax, S., Ly.		
NAIADACEÆ.				
Zostera marina, L.		Halifax, S., Ly.		
Potamogeton natans, L.		Cow Bay, Halifax. } Ly		
P. perfoliatus, L.		Cow Bay, Ly.		
P. lucens, L.			Pictou, K.	
ALISMACEÆ.				
Triglochin maritimum, L.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	
Alisma plantago, L.	Wind so H	{ Halifax, Ln., Grand Lake, S.	Pictou, K. Ly	n Truro, Ly.
Sagittaria variabilis, Engelm.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	{ Mahone Bay, Lun., B., Truro, C.
HYDROCHARIDACEÆ.				
Vallisneria spiralis, L.		n Princes' Lo, Hx, Ln, Ly		
ORCHIDACEÆ.				
Habenaria tridentata, Hook.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
H. obtusata, Richardson,				n Truro, Ly
H. Hoskeri, Torr.	Windsor, H.	{ Dartmouth, Ly. Elmsdale, K.		
H. orbiculata, Torr.		Halifax ? Ly.	Mt Dalho'ie, K	{ n Truro, Colch., Ly., Clam Harb., Guysb , B.
H. blephariglottis, Hook.		Halifax, S		Str. Canso, B.
Var. holopetala,		Bedford, Ly.		

ORCHIDACEÆ.				
H. lacera, R. Br.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
H. psycodes, Gray	Windsor, H.	Bedford, Ln., Ly., Dutchville, S.	Pictou, K., Ly	Canso, B. Truro, C.
Goodyera repens, R. Br.			Pictou, K.	
G. pubescens, R. Br.				Salmon Riv., Truro, Ly. Canso, Guysb., B.
Spiranthes latifolia, Torr.	Windsor, H.	Halifax, S		
S. Romanzoviana, Chamisso.			Pictou, K., Ly.	Truro, Colch., and Whycocomah, C.B , Ly. Sandpoint, Guysb., B.
S. cernua, Richard.		Dartmouth, Ly. Halifax, S.	Pictou, K.	
S. gracilis, Bigelow.	Windsor, H	Halifax, S., Ly., Ln.	Pictou, K.	Oyster Ponds, Guy., B. n Truro, Col., Ly.
Listera cordata, R. Brown.			Pictou, K. M Dalh'sie, K	n Truro, Ly., C. Breton, K
L. convallarioides, Hook.				
Arethusa bulbosa, L.		Halifax, Ln., Ly., S.		Mahone Bay, Lunen., B.
Pogonia ophioglossoides, Nutt.		Halifax, Ln., Ly. S.	Pictou, K.	Cape Breton, H., Mahone Bay, B.
Calopogon pulchellus, R. Br.		Halifax, Ly., Ln. S.	Pictou, K.	Cape Breton, H. Mahone Bay, B.
Microstylis monophyllos, Lindl.		n Bedford, Ln., Ly., Halifax, S.		
M. ophioglossoides, Nutt.		n Bedford, Ln., Ly., Halifax, S.		
Corallorhiza innata, R. Br.	Windsor, H.		Pictou, K.	Canso, Guysb., B., Truro, Col., C.
C odontorrhiza,		3 Mile Ho. Woods, S.		
C. multiflora, Nutt.		Halifax, S.		
Neottia Nidus-avis, L.		n Dartmouth, Ln., Ly.	Green Hill, Ly M Dalh'sie, K	Salmon River, Colch., Ly.

	Hants.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
ORCHIDACEÆ.				
Cypripedium pubescens, Willd.				Port Mulgrave, Guys., B.
C. spectabile, Swartz.			Pictou, K.	Hab? Ln.
C. acaule, Ait.	Windsor, H.	Halifax, Ly., Ln., S.	Pictou, K.	Guysborough, B.
Var. (white.)		N. W. Arm, Halifax, } Ly.		Truro, C.
IRIDACEÆ.				
Iris versicolor, L.		Halifax, Ln., S. Ly.	Pictou, K.	{ Sydney, C.B., H. Canso, Guysb., B,
Sisyrinchium Bermudianum, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
LILIACEÆ.				
Trilllium erectum, L.		Halifax, S., n Rockhead.		Hall's Harb., Kings, H.
T. cernuum, L.			Pictou, K.	
T. erythrocarpum, Michx.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Pirate Harb., Guysb., B.
Medeola Virginica, L.	Windsor, H.	{ Dartmouth, Ln., Ly., n Halifax, S.	Pictou, K.	
Uvularia sessilifolia, L.				n Truo, C., Ly.
Streptopus amplexifolius, D.C.	Windsor, H.		Pictou, K.	
S. roseus, Michx.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Canso, Guysb., B.
Clintonia borealis, Raf.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Canso, Guysb., B.
Smilacina racemosa, Desf.		{ Dartmouth and Bedford, Ln., Ly., n Halifax, S.	Pictou, K.	Truro, C.
S. trifolia, Desf.	Windsor, H.		Pictou, K.	
S. bifolia, Kerr.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Guysborough, B.
S. stellata, L.			Pictou, K.	Truro, C.
Polygonatum biflorum, Ell.		n Halifax, Ly.	Pictou, K ?	

LILIACEÆ.				
Lilium Canadense, L.				Whycocomah, CB., (Mr RG Fraser) Truro, Col C
Erythronium Americanum, Sm				Colchester, C., Ly.
JUNCACEÆ.				
Luzula campestris, D.C.		Halifax, Ln., Ly., S.		
Juncus effusus, L.	Windsor, H.	Bedford, Ly., S.	Pictou, K.	
J. filiformis, L.		Bedford, Ly.		
J. Balticus, Willd.			Pictou, K.	
J. Garardi, Loisel.	Windsor, H.			
J. acuminatus, Michx.		n Bedford, Ly., S.	Pictou, K.	
J. Marginatus, Rostkow.		n Halifax, S.		
J. ternuis, Willd.		n Halifax Common, S.		
PONTEDERIACEÆ.				
Pontederia cordata, L.	n Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Mahone Bay, B. Truro, C.
XYRIDACEÆ.				
Xyris bulbosa, Kunth.		Halifax, S.		
ERIOCAULONACEÆ.				
Eriocaulon septangulare, Witg.		Halifax, Ln., Ly., S.		Mahone Bay, B.
E. decangulare, L.		Withrod Lake, Ly., n Halifax, S.		
CYPERACEÆ.				
Dulichium spathaceum, Pers.		Halifax, S.		
Eleocharis tenuis, Schultes.		Halifax, S.		

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
CYPERACEÆ.				
Scirpus validus, Vahl.		Moser's Lake, Cow Bay, Hfx., } Ly.		
Eriophorum vaginatum, L.		Halifax, Ly.		{ Truro, Col., Ly., Cape Breton, H, Mr Poole col Mahone Bay, Lun., B.
E gracile, Koch.	Windsor, H.	Halifax, S.		
E Alpinum, L.				Cape Breton, H.
E. polystachyon, L.				{ Cape Breton, H., Mahone Bay, B.
Rhynchospora alba, Vahl.		N. W. Arm, Hfx., Ly.		
Carex Crus corvi, Shuttleworth		n Bedford, Ln., Ly.		
C. stellulata, L., var. scirpoides,		Halifax, S., Ly.		
C. vulgaris, Fries.		Halifax, Ln., Ly.		
C. torta, Boot.		Halifax, S.		
C. fulva, Good.		Bedford, Ln.		
C. folliculata, L.		Halifax, S., Ly.		
C. pendula, Huds.		n Bedford, Ln., Ly.		
C. ovalis, Good.		Halifax, Ln , Ly.		
C. Lupulina.		Halifax, S.		
C. dubitata, Dru.		Halifax, S.		
C. angustata, Boot.		Halifax, S.		
C. setacea, Dru.		Halifax, S.		
GRAMINEÆ.				
Alopecurus pratensis, L.		Bedford, Ln., Ly.		
A. geniculatus, L.		Pt. Pleasant, Ln. Ly.		
Phleum pratense, L.		Cultivated.		
Sporobolus (sp ?)		n Prince's Lod., Ln., Ly.		

Gramineæ.				
Agrostes, scabra, Willd.		Halifax, Ly., Ln. S.		
A. vulgaris, With.		Halifax, Ly., S. Bedford, Ln.		
Cinna arundinacea, L.		n Bedford, Ln., Ly.,		
Calamagrostis Canadensis, Bea			Pictou, Ly.	
Glyceria Canadensis, Trin.		Prince's Lod., Ly.		
Poa pratensis, L.		Bedford, Ln., Ly.		
Poa alsodes, Gray.		Dartmouth, Ln., Ly.		
Festuca ovina, L.		Bedford, Ln., Ly., intro.		
F. arenaria.		n Bedford, Ln.		
F. duriuscula.		Pennant, S.		
Triticum repens, L.		N. W. Arm, Hfx., Ly.		
T. maritimum.		n Bedford, Ln., Ly.		
Hordeum jubatum, L.		Bedford, Ly.		
Elymus mollis, Trin.			Pictou, Ly.	
Aira flexuosa, L.		n Bedford, Ly., Ln.		
Hierochloa borealis, Ro. & Sch.		Bedford Basin, Ln., Ly. S		
Authoxanthum odoratum, L.		Bedford, Ln., Ly.		
Setaria verticillata.			W. River, Ly.	
S. viridis, Beauv.		Grand Lake, S.		

ACROGENS.

Equisetaceæ.				
Equisetum arvense, I.	Windsor, H.	Halifax, S.		
E. pratense, Ehrh.	Windsor, H.	Musquodoboit, Ly.	Pictou, K.	
E. sylvaticum, L.	Windsor, H.	Fields, Kempt Road, S.	Pictou, K.	n Truro, Ly. Dr. Muir col.
E. palustre, L.		n Bedford, Ln., Ly.,		

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
EQUISETACEÆ.				
E. limosum, L.				Antigonish, K.
E. scirpoides, Michx.			Pictou, K.	
FIC S.				
Polypodium vulgare, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Adiantum pedatum, L.	{ Newp't, Mrs Benuett? col			
Pteris aquilina, L.	Windsor, H.	Halifax, S., Ly., Ln.	Pictou, K.	Port Mulgrave, Guys., B.
Woodwardia Virginica, Sm.		{ N. W. A. & Dartmouth Mr. Harris coll.		
Asplenium Trichomanes, L.		n 3 mile Ho., Halifax, S.		Pirate Cove, St Canso, Gs, & Gold R, Chester } B.
A: thelypteroides, Michx.	{ Windsor, H Rawdon, B.	Halifax, S., Ly.	Mt Dalho'ie, K	Sherman's Mt., P Mulg., & Manchester, Guysb., B.
A. Filix-foemina, Beruh.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Phegopteris polypodioides, Fée.	Windsor, H.	Halifax, S., Ln., Ly.	Pictou, K.	Port Mulgrave, Guys., B.
P. Dryopteris, Fèe.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, Guys., B.
Var ?	Windsor, H.			
Aspidium Thelypteris, Swartz.	Windsor, H.	{ Dartmouth, Ly. Halifax, S.	Pictou, K.	{ Port Mulgrave, B. Truro, C.
A. Novaboracense, Swartz.	Windsor, H.	Halifax, Ln., Ly., S.,		Port Mulgrave, B.
A. fragrans, Swartz.				Hartley's Waterfall, Pirate Cove, St Canso } B.
A. spinulosum, Swartz.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
Var. intermedium,				Port Mulgrave, Guys., B.
Var. dilatatum,		Halifax, Ln., S., Ly.		Str. Canso, B.
Var. obliquum,		St. Margarets' Bay, B.		Mahone Bay, Lunen., B.

FILICES.				
Var. recuvatum,				Mahone Bay, Lun., B.
A. cristatum, Swartz.		n Halifax, Ly., S.	Pictou, K.	Port Mulgrave, Guysb, B.
A. Filix-mas, Swartz.				Whycocomah, C.B, Ly. K
A. marginale, Swartz.	Windsor, H.	N. W. Arm, Halifax, Ly n Grand Lake, S.	Pictou, K.	Str. Causo, Guys., B. Truro, C.
A. acrostichoides, Swartz.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Oyster Ponds, St Canso, B.
A. aculeatum, Swartz, Var. Braunii, Koch				Ehlar's Waterfall, Guys, & Sherman's Mt. Pt. Mulgrave, B. M'ble Mt, Bras d'or Lake, C. Breton. H.
A. lonchitis, Willd.				Cape Breton, K.
Cystopteris bulbifera, Bemh.				Hartley's Waterfall, Pirate Cove, St Canso, B.
C. fragilis, Bemh.			Springfi'ld & W. River, K	LaHave falls, N Gr, Lun Clam Har Riv & Reserve L, Manchester, Gus, B.
Var. McKayii, Lawson.			n M Dal'sie, K	
Struthiopteris Germanica, Wild	nWindsor n Falm'th Rawdon, B.		Pictou, K.	Truro, C.
Onoclea sensibilis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Mahone Bay, Lunenb., B.
Woodsia obtusa, Torr.	Windsor fls, H			
W. Ilvensis, R. Brown.				Gold R, n Chester, Ln, B Salt Mt Whycocomah, Cape Br. Ly. n Truro, C.
Dicksonia punctilobula, Kunze.	Windsor, H.	Halifax, Ln., Ly. S.	Pictou, K.	Port Mulgrave, Guys, B.
Osmunda regalis, L. Var. spectabilis,	Windsor, H.	n Halifax, Ln. S. Ly.	Pictou, K.	Prt. Mulgrave, B., Cape Br, H, Mr Poole, coll.

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FILICES.				
O. Claytoniana, L.	Windsor, H.	n Bedford, Ln., Ly. Halifax, S.	Pictou, K.	Port Mulgrave, Guys., B.
O. cinnamomea, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Port Mulgrave, B.
Var. frondosa,	Windsor, H.			
Botrychium simplex, Hitchk.	Windsor, H.			Cape Breton, K.
B. Virginicum, Swartz.			Pictou, K.	Sherman's Mt., Port Mulgrave, B.
B. lunarioides, Swartz.		n Princes' Lo., Hx., Ln.		
Var. obliquum,				Oakland's Lake Mahone Bay, B.
Var. dissectum,				New Germany, Lun., B.
LYCOPODIACEÆ.				
Lycopodium lucidulum, Michx.	Windsor, H.	n Halifax, S., Ly.	Pictou, K.	
L. inundatum, L.		n Bedford, Ln., Ly. N. W. Arm and Pt. Pleasant, Ly.	n Pictou, Ly K	
L. annotinum, L.	Windsor, H.	Dartmouth, Ly. Halifax, S.	Pictou, K.	
L. dendroideum, Michx.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
L. clavatum, L.	Windsor, H.	n Halifax, S., Ly.	Pictou, K.	Truro, C.
L. complanatum, L.		Halifax, Ly., S.	Pictou, K.	Truro, C.
MUSCI.				
Sphagnum cymbifolium, Will.			Pictou, K.	
Sphagnum rubrum,		Halifax, Ln., Ly.		
S. acutifolium, Ehru.			Pictou, K.	
Sphagnum, (sp ?)		N. W. Arm, Halifax, Ly.		

Musci.			
Polytrichum commune,		Halifax, Ly., Ln., S.	Pictou, K.
Polytrichum juniperium,		Halifax, S.	
Atrichum undulatum,			Pictou, K.
Bartramia pomiformis,			Pictou, K.
Mnium punctatum,		n Bedford, Ln., Ly.	
M. Drummondii, Br. & Sch.			Pictou, K.
M. cuspidatum, Hedw.			
Hypnum splendens,		Halifax, Ln.,	Pictou, K.
Hypnum (sp ?)		Halifax, Ly.	
Pogonatum brevicaule,			Pictou, K.
Dicranum polycarpon, Ehrh ?			Pictou, K.
D. heteromallum,			Pictou, K
D. undulatum, Turner.			Pictou, K.
D. scoparium ?		Halifax, Ln., Ly.	Pictou, K.
D. varium, Hedw.			Pictou, K.
Funaria hygrometrica,		Halifax, Ln., Ly.	
Phascum subulatum,		n Halifax, S.	
Buxbaumia aphylla,		N. W. Arm, Halifax, } Ln.	
Leucobrium glaucum,		Halifax, Ln., Ly.	

MUSCI.—Additional,—Collected by A. H. McKAYE, Pictou Academy.

Ceratodon purpureus, Brid.
Leucobryum glaucum, Hempè.
Fissidens taxifolius, Hedw.
Fissidens (sp ?)
Trichostomum torlile, Schrad.
Tetraphis pellucida, Hedw.
Orthotricum Ludwigii, Schrad.
O. Crispum, Hedw.
O. crispulam, Hornsch.
Pogonatum brevicaule, Brid.
Atrichum angustatum, Beauv.
Aulacomium heterastichum,
Bryum pyriforme, Hedw.
B. annotinum, Hedw.
B. nutans, Schreb.
B. Capillare, Hedw.
B. cæspiticium, L.
Cylindrothecium seduatrix ?
Neckera pennata, Hedw.
Climacium Americanum, Brid.
Hypnum gracile, Brosch.
H. triquetrum, L.
H. Brevirostre, Ehrh.
H. Schreberi, Wild.
H. Cordifolium, Hedw.
H. Crista-castrensis, L.
H. Molluscum, Hedw.
H. Cupressiforme, L.
H. salibrosum, Hffm.
H. lætum, Brid.
H. elegans, Hooker.

HEPATICÆ.—A. H. McKaye.

Jungermania bicuspidata, L.
Frullania Grayana, Monta.
Madotheca platyphylla, Dum.
Ptelidium ciliare, Nees.
Trichocolea tomentella, Nces.
Mastigobryum trilobatum, Nees.

Hepaticæ.	Hants.	Halifax Co.	Pictou Co.	Et. Al.
Marchantia polymorpha, L.		Halifax, S., Ly.	Pictou, K.	
Jungermania sphagni, Dicks.		Halifax, S.		

THALLOGENS.

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
LICHENES.				
Usnea barbata,		Halifax, Ln., S. Ly.	Pictou, K.	
U. plicata,		Halifax, S.		
Alectoria jubata,		Margaret's Bay, Ly.		
Cetraria Islandica,		Halifax, S.		
Scyphopherus cocciferus,		Halifax, Ln., S., Ly.		
S. pyxidatus.		Halifax ? Ln., S.		
Variolaria communis,		Halifax, S.		
V. amara,		Halifax, S.		
Peltidea horizontalis,		Halifax, S.		
Stereocaulon (sp ?)		Halifax, Ly.		
S. paschale,			Pictou, K.	
Parmelia parietina,		Bedford, Ly.		
P. olivacea,		Halifax, S		
P. herbacea,		Halifax, S.		
Umbilicaria pustulata,		N. W. Arm, Halifax, Ly.	Pictou, K.	
U. Muhlenbergii,		n Bedford, Ln., Ly.		
U. Dillenia,		n Margaret's Bay, Ly.		
Cornicularia jubata,				
Ramalina fraxinea,				
Sticta pulmonaria,		Halifax, S.	Pictou, K	
S. scrobiculata,			Pictou, K.	
Bæmocyes roseus,			Pictou, K.	
Cladonia extensa,			Pictou, K.	
C. bellidiflora,			Pictou, K.	
C. pixidata,		Halifax, S.	Pictou, K.	
C. rangiferina,		Halifax, Ln., S., Ly.	Pictou, K.	

	Hants.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
LICHENES.				
C. gracilis,			Pictou, K.	
Cladonia (sp ?)			Pictou, K.	
Cenomyce alicornis,		Halifax, S.		

ALGÆ.	
*Alaria esculenta, Grev.	Rocks at low water mark ; Nova Scotia and S. to Cape Cod, Ln.
*Laminaria Fascia, Ag.	Rocks and stones near low water mark, Halifax Harbor, Ln.
*L. longicruris, Pylaic.	Abundant Halifax Harbour, below low water mark, Ln., Ly.
*L. digitata, Lam.	At and below low water mark, Halifax; common as far S. as Cape Cod, Ln.
*Agarum Turneri, Post & Rupr.	Below low water mark, off Point Pleasant, Halifax, Ln.
*Chorda Filum, Stack.	Abundant Bedford Basin, Halifax, between tide marks and extending into deep water, Ln.
*C. lomentaria, Lyngbye.	Coast of Nova Scotia and S. to Charleston, S. C., Ln.
Rhodymenia palmata.	Halifax Harbour, Ln., Ly.
Fucus vesiculosus.	Common on rocks and stones near low water mark, Ln., Ly.
Ptilota (sp ?).	Cow Bay, Halifax, Ly.

*Laminariaceæ of the Dom. of Canada, etc., by PROF. LAWSON, Trans. ; N. S. Inst. Nat. Sc., Vol. II., Part 4, Art. XI.

FIELD DAY.—Institute of Natural Science.

The Institute of Natural Science, pursuant to notice to its members, had an interesting Field Day, on Thursday, the 24th, August.

It happened on this occasion that pressing avocations on the part of some, and absence from Halifax on the part of others, prevented a general attendance; but fourteen gentlemen assembled, making a fair representation of the Sections which compose the Institute. They left for Grand Lake by the 8 a. m. train, and commenced explorations on their arrival at the Wellington Station. These were chiefly Geological, led by the Rev. Dr. Honeyman, the Honorary Secretary of the Institute. Several places were visited, where the smooth surfaces of the Lower Silurian, or even Lower Rocks, were exposed, and the glacial striation very plainly marked, the direction of which was S. 30°. W. by compass, with some slight variation caused probably by erratic movement of the abrading glacier, by which the country at one time must have been entirely covered. This course differs somewhat from the more plainly marked striæ of Point Pleasant, close to Halifax, where with slighter variation, it is about S 30°. E. The Lower Silurian is here, (coasting the Grand Lake,) entirely metamorphosed clay slate, penetrated by small bands or veins of quartz. It is the Gold district Onward, on the opposite side of the road, at a short distance, is the remarkable phenomenon of a *knoll* of carboniferous conglomerate, the remains possibly, of a carboniferous beach, lying on the upturned edges of the older strata, the intervening formations being all absent; but this being left, shows the changes our solid earth must have undergone during the past, almost unlimited, period of its eventful history. Other places were visited of Geological interest. Indications of travelled drift were frequent—syenite, greenstone, porphyries, and further onward, amygdaloid and other trap,—all serving to illustrate the conclusion of Dr. Honeyman, of their passage in one direction from the Cobequid range, in another from the region of Blomidon, and the Trap District of the Bay of Fundy.

Dr. Sommers, of the Botanical Section of the Institute, made an interesting collection of plants for his herbarium, assisted by other members of the Institute.

The Zoological Section had very little to do in the way of observation or collection, so far as wild nature was concerned. Some beautiful butterflies disported in the summer sunshine The snakes, frogs and toads made themselves very scarce on this occasion.

In this way the time passed, until near 1 p. m., the party arrived at Oakfield, the extensive estate of Colonel Laurie, where they were met by the hospitable proprietor, and conducted to the top of his mansion, to view a splendid panorama of the surrounding country, embracing the

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

PATRON—His Honor The LIEUTENANT GOVERNOR.

COUNCIL, 1875-6.

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.

(REPRINT.)

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

OF

HALIFAX, NOVA SCOTIA.

VOL. V. 1879-80. PART II.

CONTENTS.

APPENDIX.

HALIFAX, NOVA SCOTIA—WILLIAM GOSSIP, 103 GRANVILLE ST.
ENGLAND—REEVES & TURNER, 196 STRAND, LONDON.
UNITED STATES—THE NATURALIST AGENCY, SALEM, MASS.
1880.

ANNIVERSARY ADDRESS, 1879.

By Wm. Gossip, F. R. M. S., *Presidsnt.*

Two years have elapsed since I had the honor of addressing the Institute on our anniversary, with reference to its proceedings and prospects. Then, in the absence of the worthy President, being next in office, I thought it right that one of our rules bearing upon this duty should be observed, lest it might be lost sight of altogether. Since that time you have done me the honor to choose me your President, and now it is more than ever a duty imposed upon me not to allow a rule deemed essential to the well-being of the Institute to remain inoperative, although what has to be said may not, on every occasion, be specially interesting, or largely instructive.

Science is ever progressive. True science is never lost. What the mind of man has once conceived and practically realized is almost always retained, and is never entirely forgotten. Indeed, the empire of science is so widely extended, and its influence so general, as to be beyond the possibility of decay or extinction. All nations interest themselves in its advancement, and by generous impulses contribute to its resources. Knowledge has wonderfully increased, and we may well be proud that our own mother land leads the van in the cause, and, more than all others, has largely aided and encouraged the almost universal enlightenment.

When the world is prepared for great discoveries they are usually vouchsafed. The art of Printing, which is now so expansive, perpetuates invention; and steamships and railways, electricity and magnetism, annihilate space, and bring to a focus of general utility the scientific conceptions of every clime. Human intellect has so far mastered the arcana of nature as to be able to control, to a certain extent, some of her most subtle agencies, and make them obedient to its own guidance. With apparent facility, an electric current is conducted thousands of miles, through air and water, and causes a message to be delivered with exactness and truth in intelligible language. The same subtle fluid, by the same agency, bids fair to be an useful auxiliary of the less mighty steam-engine—a mechanical power, and a means of propulsion ; and will, perhaps, in a short time, be economized to dispel the darkness of night in our large cities. The telephone enables individuals to converse, each one from his own chamber, over widely intervening spaces; and ere long sound may rival electricity in instantaneous communication. Except in imagination there is no power that thus mocks at distance. If we would find something analagous we must invade the realms of fiction. The authors of the *Arabian Nights Entertainments* do no more, who send princes and princesses through the air on enchanted horses, by the twist of a peg, thousands of miles in a moment—literally with the speed of thought; and our own immortal Shakspeare, perhaps dreaming of an ocean cable, evokes an adventurous sprite, able to "put a girdle round the earth in forty minutes." These were the wildest vagaries of imagination, which have become in the nineteenth century sober realities.

The imaginative standard of the past having thus been reduced to a fixed value, I may be permitted further to illustrate the practical necromancy of modern times.

Daguerre, in 1839, after years of experiment, at length by a wonderful but simple process, transmitted the human portrait from life to plates of silvered copper, made sensitive to solar light by the vapour of iodine. Soon thereafter, the principle thus fully developed, improvements sprang up on every hand, and the results so far are beautiful photographs, made permanent by autotype, which give the most accurate delineations of works of art as well as natural objects. It is not to be supposed that they will stop here, or that science has done with them. Genius will in time be able to fix the colours of the camera, as well as its shadows.

Again, experiments on light, following a growing knowledge of the laws by which it is governed, have produced the spectroscope, and now scientists assume, from careful analysis of the solar atmosphere, that they have a clue to ascertain the substance of the sun.

In connection with this subject, the experiment of Mr. Lockyer, a distinguished savant, an editor of *Nature*, a journal well known in the world of science, with reference to the solar and stellar spectra, are of much interest. He has started an hypothesis, and justified it by experiment—that the elements themselves, or at all events some of them, are compound bodies, and that hydrogen is the principal elementary substance represented in the spectra. I cannot find in what Mr. Lockyer has written that he goes farther than this, if quite so far. But the *Medical Tribune* of April 15—a journal of scientific pretentions, published in New York—contains a well-written article by Dr. Wilder, its editor, based upon the Papers in the No. of *Nature* I have quoted, in which the argument of Prof. Lockyer is asserted to be, "that in hydrogen we have matter reduced to its lowest terms—*the only one element*." I do not think myself that Prof. Lockyer has made this a distinctly definite conclusion, but it affords at all events to the writer in the *Tribune*, an opportunity to assume for the hypothesis, or theory, of our associate, Mr. Dewar, and his friend Dr. Fraser, a like degree of credence. These gentlemen have long since announced, in their ato-magnetic theory, that all primal atoms are either hydrogen or oxygen, mineral or vegetable, which approaches the hypothesis or theory of Prof. Lockyer, as stated by the *Tribune*, but is of earlier date, and were it substantiated by experiment, would be as little objectionable. The writer in the *Tribune*, favorable to Mr. Lockyer's hypothesis as to the principle involved, objects "that as hydrogen is not a luminous substance, and, therefore, is of itself without motion, and, being molecular, must have been built up from atoms of a still more elementary character, there must be some force acting upon it to set its atoms in motion." Here again comes into play Messrs. Dewar and Fraser's plausible theory of the magnetic polarity of atoms. He quotes the suggestions of other scientists to account for this motion; also, that electricity, by inducing the primal atoms to assume polarity, may cause the first motion by means of the attraction and repulsion of the two poles, the positive and the negative; and gives a reason to show that the element denominated hydrogen, when negatively electric and uncombined, is identical with the substance known as oxygen. Thus the theory is similar to that of Prof. Lockyer, but with a difference. I do not pretend to understand the processes which have prompted these several speculations, generally alike. Neither appears to have advanced much beyond the confines of enquiry, and we may be content to await with patience their further investigation. To those interested in its progress, I would recommend a study of the articles in *Nature* of January, 1879, and to supplement them with that in the *Medical Tribune* of April 15, following. Perhaps in time the spectroscope may help us to a satisfactory solution of the difficulties.

To the spectrum and the microscope we may look for some of the most valuable discoveries ever made in the realms of science.

At the risk of being thought discursive or digressive, I beg leave to refer to an event of great interest, with which we may be all more or less familiar, which makes us better acquainted with microscopic revelations, and brings us so close to the beginning of life, that the power to produce it from lifeless elements appears to be almost within our grasp.

The English papers, by the royal mail steamship which arrived early in September, are occupied with lengthy accounts of the anniversary meeting of the British Association at Sheffield on the 20th August. These anniversaries have lost none of their interest for the British people. We learn from them the importance attached by all classes to scientific investigations. The Press uses its powerful combinations to spread abroad, with the utmost rapidity, over all the Empire, and to foreign countries, full details of the proceedings, employing for that purpose the energies which art and science have placed at its disposal. The railway and locomotive, the marine engine and screw propeller, the ocean cable and electric telegraph, all triumphs of science and genius within a century, engage in the work. Photography also, takes the portraits of the President and other scientists of the Association, and then by electro-metallurgy makes them typography, placing before us in a newspaper correct likenesses of the men who, in Great Britain, contribute to the scientific advancement of the nation. Do we desire to know the subjects which engage the minds of these men ? The press communicates them in twenty-four hours after their delivery. They reach us by electric telegraph as quickly on this side of the Atlantic. In twelve days at farthest, by steam navigation. I may call all this the artistic application of Natural Science. The substance of the President's address is before me. It treats of Protoplasm. He describes "Protoplasm, or living matter, as lying at the base of all living phenomena." * * "a tangible and visible reality, which the chemist may analyse in his laboratory, the biologist scrutinize beneath his microscope and dissecting needle. All over the world, in fresh water and in salt, minute particles of protoplasm may be detected. In the famous amœba, which has arrested the attention of naturalists, almost from the commencement of microscopical observation, we have the essential characters of a cell, the morphological unit of organization, the physiological source of unicellular existence. But cells combine into organs, and organs into animals. Yet in the most complex animal the cell retains its individuality. * * * *

This, though not entirely new, is a lucid description of great interest, and what follows ought to command earnest attention besides:—

"Examine under the microscope a drop of blood freshly taken from the human subject, or from any of the higher animals. It is seen to be composed of a multitude of red corpuscles, swimming in a nearly colourless liquid, and along with these, but in much smaller numbers, somewhat larger colourless corpuscles. The red corpuscles are modified cells, while the colourless corpuscles are cells still retaining their typical form and properties. These last are little masses of protoplasm, each enveloping a central nucleus. Watch them. They will be seen to change their shape. They will project and withdraw pseudopodia, and creep about like an amœba. But more than this, like an amœba, they will take in solid matter as nutriment. They may be fed with coloured food, which will then be seen to have accumulated in the interior of their soft transparent protoplasm; and, in some cases the colourless blood corpuscles have actually been seen to devour their more diminutive companions the red ones."

All this is very wonderful, and to many whose opportunities of microscopic observation are rare must appear entirely new. They might have been prepared for the modified cell of the red corpuscle, but the protoplasmic—the living condition of the white—feeding as it were, upon itself, has only been revealed by the highest powers of the microscope. We have it on Supreme authority as to the animal, that "the blood is the life thereof," but whoever could have supposed that this divine truth would be proved to the senses after this manner. I should imagine that the knowledge is of the highest importance. Our M. D.'s are called upon now to adjust the equilibrium between the red and white corpuscles—to lessen or increase the cannibal instincts of the white, and so to cleanse the impurities that interfere with a healthy circulation, and which are the fruitful generators of disease.

The instances quoted illustrate the phenomena of the protoplasmic cell, which is the basis of the physical life in animals. But there are other wonders. It is precisely the same in the vegetable kingdom. The President proceeds to give a number of examples to show that the primary cell in plants is identical with that in animals, and undistinguishable from it. "The spores which swim about in the field of the microscrope, driven by vibrating cilia, and avoiding collision with obstacles in their way, behave exactly like the amœba." Dr. Fraser may tell you that this motion and careful avoidance of obstacles is due to their magnetism and polarity. "But the most curious illustration of the identity of the elementary life in plants and animals, is found in the fact that the former as well as the latter are subject to the influence of anæsthetics. A sensitive plant confined under a bell-glass, with a sponge filled with ether, soon ceases to manifest any sensibility. Withdraw the sponge, and it will speedily recover germination. Fermentation may be arrested by the same means. Seeds of cress kept under the influence of ether for five or six days, remain quite passive. But they were only *sleeping*, and not killed. As soon as the ether was removed, germination set in at once with activity. The same thing is true of fermentation." It was stated as the results of all these investigations, "that in protoplasm we find the only form of matter in which life can manifest itself, and that though the outer conditions of life—heat, air, water, food—may be all present, protoplasm would be still needed, in order that their conditions may be utilized. It would, however, be a mistake to suppose that all protoplasm is identical. Of two particles of protoplasm, between which we might defy all the powers of the microscrope, all the resources of the laboratory to detect a difference, one can develop only to a jelly-fish, the other only to a man, and one conclusion alone is here possible,—that deep within them there must be a fundamental difference which thus determines their inevitable destiny, but of which we know nothing, and can assert nothing beyond the statement that it must depend upon their hidden molecular constitution."

And here I would venture a crude idea—that if protoplasm, as revealed by the microscope, is really the beginning of life, its ultimate development may depend less upon a hidden molecular constitution in the cell units, in which no differences can be discovered, than upon cell aggregation. Or, is it produced according to Dr. Fraser's theory, by the atoms assuming polarity, being vivified by magnetic action. The last would not be spontaneous generation, but something analogous. Really, all we know is, that like in the animal and vegetable proceeds from like. But it is an important admission by Dr. Allman, to which I would join the idea just expressed, "that his assertion does not in the least diminish the vast difference which separates lifeless from living matter, nor lessen the mystery of life itself. No chemist has yet built up one particle of living matter out of lifeless elements." Or, as I understand it, no chemist, or magnetist, or electrician, has yet made *protoplasm*, or brought together atomic conditions necessary to create unicellular existence, much less to endow "*an aggregate*" of cells with the direction of a positive animal life—a reason for which I think is satisfactorily given in the Book of Genesis, chap. 3, v, 22 to 24.

The foregoing are *a few short extracts* from the president's address, interspersed here and there with some passing observations; for I have felt, in the relation, that I may not only be too diffusive, but that I am trenching somewhat on the province of our talented associate and microscopist, Dr. Sommers. I have only further to hope that our Institute will soon possess microscopic instruments of sufficient power to enable *him* to show us all those microscopic experiments and microscopic life, the wonders of which have been for some time known to the scientists of other countries. From these anticipated resources we may, I think, reasonably expect, that in this to us new field of investigation, discoveries will be made that will prove our high estimation of this valuable branch of Natural Science, and perhaps enable us, in an hitherto untried zone of research, to contribute a little to what has been already realized.

Yet, after all the wealth of scientific discovery of our day, and our pride in it, which sometimes amounts to inflation, I think it must be conceded by sober reason that human progress, great as it is, has reached no further than the threshold of the temple of science, the golden pinnacles of which seem now and then to greet our vision high above the clouds of obscurity. The motto of its votaries must still be "Excelsior!" Still it is not as in the past ages, that speculative science, assuming the general ignorance, stands for truth, or is received without strict examination. The world has had much to unlearn of what had been for long periods received as indisputable. The earth, without further controversy, rolls round the sun, and is no longer a flat surface girdled by an unknown ocean. Even within a century revealed religion has been placed, I think, upon a surer basis by scientific interpretation. Geology, with yet much to unfold, so far shows us that the world (I say it with reverence) was not made in six natural days, although the sequence of creation corresponds more exactly with a reasonable and no doubt a more correct interpretation of the Divine record; and crude deductions with respect to the effects of the Noachian deluge, are fast giving way before investigations which, without ignoring that great event, or any of its phenomena, reasonably attribute much that was presupposed to belong to it, to other and remoter causes. These truths are intimately connected with and lie at the foundation of many of the grand discoveries of the age. Some of them are dogmas now, and all will be so with succeeding generations. The difficulty with them is the self-sufficiency and scepticism they engender, and to restrain their assertion within the bounds of propriety. Science and religion ought to dwell in perfect harmony. True science can do no more than accommodate each to each by the operation of the laws of eternal truth. This is being done gradually but surely. If some of the most celebrated searchers into nature of our own day could wake up a century hence, they would, without doubt, be as much astonished at the stride of knowledge meanwhile, and the consequent disturbance of previous belief, as those would be who have lived a century before our era, could they now start into living consciousness of the past and present.

It may excite a smile that I should imagine so curious an event; but we may still consider it certain, that a comparison of notes would realize to all their minds the practical truth enunciated by one of the wisest among them, as true as when it was uttered, as to all that has been done, to wit: that we are only as children picking up pebbles from the shore, while the great ocean of truth lies unexplored before us.

But it is time that I should come nigher home. In Nova Scotia, within ten days' distance by steam of the mother country, and adjoining the great republic,—where we have unsurpassed facilities for acquiring a knowledge of and utilizing the latest scientific progress and discoveries,—it might be supposed that we would be practically acquainted with and profit by them, and with everything recognized as improvement. The necessity, however, is conceded but slowly, and we have not much to boast of in this respect. Our scientific pursuits are nearly all limited to a college curriculum,—to a course of chemistry, electricity, botany and cognate sciences. This is doubtless an excellent preparation, but as yet, so far as we know, no further fruits have been produced. It is a college education—nothing more. There may be various reasons for this. Nova Scotia, though early settled, has never been very well known in the world, especially in the world of science. Capital and enterprise have not been largely employed to call her material resources (not to mention those which are inert) into active operation. She has looked to other means of wealth which were more readily procurable, but which, whatever they may have been, are not now steadily profitable. She is, in fact, so far as science is concerned, much behind the age. The urgency is, however, being rapidly forced upon her, that resources but partially used, or not used at all, must soon be called into action, if we would play our part as an integral portion of British America. There is enough of talent and ability amongst ourselves to take secondary action in their development, although neither speculation nor capital at present appears very eager to make them available. It certainly does seem strange, that we cannot even point to the existence of a cotton-mill, with a chief city which is the Atlantic entrepot of a Dominion stretching from Halifax to the shores of the Pacific, possessing as we do railway communication for a long distance inland, and, as we shall do in a few years, from hence to British Columbia, to say nothing of the limitless coal and iron in Nova Scotia, and a cotton growing country within twenty days' sail of our chief port. A reason may be found on the part of our own people in the want of capital for so expensive and important an undertaking, and ignorance of its management. But that our unsurpassed geographical position, and the acknowledged decadence of British manufactures, through rivalry of foreigners, should not have turned the attention of the cotton lords of England to Nova Scotia, from whence to supply the growing Dominion, and to carry the war into the enemy's territory, is something not easily understood. I may be pardoned this allusion. It is not so far beyond the domain of natural science, involving as it does many of its branches, that our wishes and hopes may not centre in such an enterprise.

Of our other industries connected with natural science, I will speak briefly. Coal is inexhaustible, and I hope to see the day when cotton and sugar and iron, and other manufactories at home, shall preclude the necessity of looking for a market abroad for this valuable mineral; and when our own Dominion, the western part of it especially, shall be more ready to buy from us than we to sell to them. This is the true solution of the problem of coal mining as a source of national wealth. The time will surely arrive, and we hope is not far distant, whoever may live to witness it. Strange that even now our interests should be diverse, or not to be reconciled, and that we cannot work together as an united people.

Iron is as inexhaustible as coal, and more valuable. One blast furnace is at work for the reduction of its ores, requiring scientific knowledge and practical industry and economy to sustain it, and these will no doubt multiply as markets are realized and demand increases.

The rocks of the Atlantic coast line, from Canso to Yarmouth, and for a considerable breadth inland, are prolific in gold, which, even now, is worked profitably, and wouldbe much more so if science and capital were largely employed in its development.

Promising indications of Copper are frequent, even within a short distance of the capital, but they have not tempted eager speculation or scientific research. Copper, which requires patient and expensive exploration, is as yet only talked about as a Provincial enterprise. The same may be said of Silver and Lead, which are believed to exist in workable quantities, only awaiting capital and skill, as employed in other countries, to make them largely profitable.

It is high time that we knew the extent of our natural resources. I would like to be able to state that an exhaustive geological survey of the Province had been made, and its mineral riches mapped with some degree of certainty. We should know by this time if they are as valuable as they have been assumed to be, or otherwise. All doubt upon this subject ought long since to have been set at rest. The geological survey of Canada, provided for by the Dominion Government, began at the wrong end.

It will be expected, I presume, that I should, before I conclude make some reference to the work of the Institute during the past year. I shall do so as shortly as possible. I make no comparisons and do not claim for it any great originality, or superlative merit. It is but an humble follower in the wake of more richly freighted argosies. I shall merely assert, therefore, that it has furnished a large amount of information on the geology, mineralogy, zoology, botany and meteorology of Nova Scotia, which otherwise would not have been generally known. In that branch of science first mentioned I will take the liberty to allude to the articles of the Rev. Dr. Honeyman, which of late have been directed to a correction of the geology of our own Province. On the evidence of position and palæontology, strata which previously were supposed to be widely extended, are proved not to exist, or to belong to lower formations. I recommend these papers, which will be found in our published Transactions, to the careful attention of all acquainted with the science, who take an interest, for economic purposes or otherwise, in the succession and deposition of the rocks, as a guide to the mineral resources of Nova Scotia. A careful study of them may prevent many mistakes of scientific importance. The department of geology, I regret to say, was badly represented at the Provincial exhibition; but even there was some encouragement, and those who sought may have found very fine specimens of coal from the

Little Glace Bay, Pictou and other mines; gold specimens from Oldham and Montague, and from the latter, within a distance of eight miles from Halifax, a brick (so called) of gold, a month's work of fourteen men, valued at $7,666.92, taken from the "Rose" lode. Also sulphuret of and native copper, and galena and silver,—with some fine specimens of granite and syenite, freestone and other rocks and minerals, awaiting science, industry and capital for their complete development.

In like manner I desire to draw attention to the papers of my friend, Dr. J. Bernard Gilpin (now absent), on the Zoology of Nova Scotia. Dr. Gilpin has successively drawn upon the mammals of Nova Scotia (Indians included) for description, until he has left none remaining the history of which he has not noted. It is almost the same with the fishes that frequent or are native of our coast and inland waters. In a recent No. of the Transactions he shows us the salmon "from his first appearance as a minnow, and through all his changes, until lastly he gives us a drawing of his degeneration (degradation I should call it) in colour and leanness, and the almost grotesque changes in the jaws of the male during spawning. He is also of opinion, against preconceived belief (in which he is supported by Mr. Wilmot, of the fish-breeding establishment at Bedford), that all our salmon are retained during the winter in our lakes and inland waters.

J. Matthew Jones, F. L. S., formerly President of the Institute, to whom we are much indebted for papers on various subjects, has contributed, in an Appendix to the Transactions of 1879, a list of the fishes of Nova Scotia, corrected to date, in the preparation of which he manifests great research, and acknowledges the generous assistance of his much esteemed friend, Prof. G. Brown Goode, of the Smithsonian Institute, Asst. United States Fish Commissioner. This paper will be much valued for the information given, and for future reference.

Dr. Sommers, Prof. of Microscopy, and the Rev. E. Ball, of Maccan, furnish botanical papers of merit and usefulness—the former on Nova Scotian Mosses, the last named gentleman on Aspidium Spinulosum—*Grey*. Dr. Sommers has also furnished a paper on Microscopy.

Mr. H. Louis, Assoc. Roy, School of Mines (a recent member of our Institute), communicates a paper on "The Analysis of a New Mineral from Blomidon." For this contribution to science, with reference to which Prof. Dana, to whom it was submitted, remarks that there is nothing like it in Mineralogy (meaning that it is an original discovery), Dr. Honeyman has suggested the name of "Louisite," by which it will henceforth be known. Also, a valuable paper "On the Ankerite Veins of Londonderry, Nova Scotia," with copious analyses. This gentleman, from whose talent much was expected, on behalf of the Institute, and the country especially, has left our shores to fill a more responsible situation in England.

"The Limonite and Limestones of Pictou County," is the title of a paper bearing on the economic mineral resources of Nova Scotia, by Edwin Gilpin, A.M., F.G.S. The processes of nature, by which these minerals were formed, are lucidly accounted for and described, and their value shown to be considerable. According to the author they appear to occupy positions similar to the marine limestones at Whitehaven, and Furness, and the Mendip Hills in England,—and are, by some, considered to have been deposited in a similar manner to the large deposits of Limonite, the lower silurian calciferous formation in Pennsylvania. The limestone of Artzberg and the Thuringian Forest are believed to have been formed in the same way.

Mr. Dewar has a paper on his favorite subject of Ato-magnetism—which I have previously noticed in connection with the spectrum discoveries of Prof. Lockyer, and the article in the *Medical Tribune.*

Mr. Mellish, a secretary of the Institute, placed on record at the close of last session an interesting description of fish culture in Nova Scotia, stating that a total of 4,800,000 salmon has been distributed from the hatchery of Bedford Basin during the short space of four years.

On other matters concerning the Institute and its working, I shall be very brief. We have friendly correspondence with many sister societies in various parts of the world. The Royal Microscopical Society of London, recently passed a resolution, which recognizes for your President, for the time being, the honor of appending F.R.M.S. (Fellow of the Microscopical Society) to his name, of which honour, however unworthy, your humble servant has been the first recipient. This recognition of the Institute is of some value, and has been suitably acknowledged; and I hope before long we shall be able to show, by practical illustration, that it is not undeserved. We exchange our Transactions with the valuable monthly publications of the R. M. S.

Best of all, perhaps, is the statement I am able to make—that we owe no man anything.

I would fain have closed with this gratifying announcement;

but a sorrowful task still awaits me, viz., to notice that, during the past year, we have had to lament the decease of three of our most zealous and useful members, and very good friends. You will find obituary notices of them in the published Transactions. It is again a painful duty imposed upon me to mention a fourth bereavement in the death of Dr. How, Professor of Chemistry, King's College, Windsor (not latterly a member of our Institute, but a frequent contributor to its Transactions), which took place at Windsor on the 27th September last. Dr How was an able scientist, and had made some interesting mineralogical discoveries in Nova Scotia. He filled the professorial chair with credit to himself and the University, and with much advantage to the students, by whom he will long be remembered, and his death regretted. His loss must be deeply felt by the Institution at Windsor, which he adorned by his talents and amenities ; and it will not be easy to fill a chair, the duties of which require in an eminent degree high qualifications and systematic order.

I have now, amid avocations which leave me little leisure for work like this, endeavored (imperfectly enough, I know) to perform a duty prescribed by the rules of the Institute. I fear I have wearied you with an address which, like many others of the kind, on similar occasions, has not the merit of propounding startling hypotheses or original theories. It may, however, serve to show that we are in earnest, and if it has the slightest effect in stimulating pursuits and studies within our reach, it will fulfil my highest expectations. I would have liked to be able to tell you that our people take as much interest in natural science—comparatively, of course—as the people of England do in the work of the British Association, or that the knowledge of Nova Scotia we have conveyed, which is by no means unimportant, is as highly appreciated among ourselves in this our own home, as it seems to be in other countries. This desire, however, is premature, and many of us may not await the better time coming. Instead, we must, I suppose, rest content with being the pioneers of science in Nova Scotia, and leave it to future generations to enter into and profit by our gratuitous and disinterested labors.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 2.

Dalhousie College, Oct. 8, 1879.

ANNIVERSARY MEETING.

WILLIAM GOSSIP, ESQ., *President, in the Chair.*

Inter alia.

The following Gentlemen were elected Office-bearers and Council for the ensuing year:—

President—WILLIAM GOSSIP.

Vice-Presidents—Prof. JOHN SOMMERS, M. D., Prof. GEORGE LAWSON, PH.D., LL.D.

Treasurer—W. C. SILVER.

Secretaries—REV. DR. HONEYMAN, and JOHN T. MELLISH.

Council—DR. GILPIN, HON. L. G. POWER, J. M. JONES, ROBERT MORROW, ANDREW DEWAR, AUGUSTUS ALLISON, ALEX. MCKAY, W. S. STIRLING.

On Motion the PRESIDENT was requested to deliver an Address at the next meeting of the Institute.

ORDINARY MEETING, Dalhousie College, Nov. 10, 1879.

The PRESIDENT *in the Chair.*

A larger than usual, number of persons were present. Among them were His Honor the LIEUTENANT-GOVERNOR, MISS ARCHIBALD, and COL. STEWART, aid-de-camp.

The PRESIDENT delivered a lengthy and interesting Address, which will be found in the *Transactions.*

MR. MORROW drew attention to an error in the published *Transactions* of 1878-1879. Appendix, page 94, MR. JONES states that MR. R. MORROW informs him that "Scomberesox Storeri"—bill fish—is seen on the coast of Cape Breton during the month of August. MR. MORROW stated that he had seen them in Pictou Harbor.

DR. HONEYMAN, the *Secretary*, gave a popular and interesting description of the Geology of Annapolis County, especially that of the Moose River Iron

Deposits. This was the substance of a paper which will also be found in the *Transactions.*

His Honor the LIEUTENANT-GOVERNOR then made some complimentary observations on tha Addresses delivered, and referred to the valuable work of the Institute, as illustrated by its Volumes of Proceedings and Transactions published. By means of its publication the Institute has been instrumental in disseminating reliable information on the Natural History of Nova Scotia in all its branches. He had just been enabled to meet the demands of Kew Gardens for information regarding the Botany of the Province, by the gift of a series of Papers published in the *Transactions.*

ORDINARY MEETING, Dalhousie College, Dec. 8, 1879.

The PRESIDENT *in the Chair.*

Inter alia.

DR. J. BERNARD GILPIN made some observations on specimens of supposed rude pottery found in and around Grand Lake. The specimens belong to the Provincial Museum. Their forms are so singular as to occasion a diversity of opinion regarding their character and origin. DR. HONEYMAN, who furnished the specimens, has no doubt whatever that they were made by man, and that they are prehistoric remains. Some of them are of regular and rather elegant shape. The basis on which they have been formed are stones—quartzite or argillite. The other material seems to have been constructed by successive layers of clay (?) so that the interior of the articles have a concentric appearance—the outside is somewhat smooth. They are somewhat firm when wet, when dry they are very fragile. When the Lake has the water at the usual height they are said to be seen lying at a depth of six feet or more. Some consider them to be concretionary, or natural forms. The stony nucleus or basis is always exposed; when the form is saucer shaped it constitutes the bottom. Their mode of occurrence and other matters will be fully investigated in the next dry and favorable season.

DR. GILPIN also exhibited a drawing of an unknown mammal. It was supposed to be an *albino* dormouse. It was found at Annapolis last summer.

DR. LAWSON gave an interesting account of his investigation of a very thick deposit of diatomaceous clay found in the Lakes of Halifax Water Works. He illustrated the character of diatom structure and mode of growth on the black-board, and by the microscope.

He also exhibited specimens of Cotton, Rice, and Palmetto which has been brought lately from the Southern States by Mr. ANDREW JACK.

It was announced that Prof. DEMILLE and W. H. NEAL had been elected members.

ORDINARY MEETING, Dalhousie College, Jan. 26, 1880.

THE PRESIDENT *in the Chair.*

Inter alia.

DR. GILPIN exhibited the Cub of a Bear, which was regarded as of peculiar interest. An account of it will be found in the *Transactions.*

Prof. LAWSON was then called on by the President to read his Paper "On Native Species of Viola of Nova Scotia."

The Paper was lengthy and interesting. It was well illustrated by means of the blackboard, and numerous dried specimens of the Viola. A conversation followed the reading of the Paper.

DR. SOMMERS also gave the substance of a Paper "On Nova Scotia Fungi." This Paper was illustrated by dried specimens.

A discussion followed.

ORDINARY MEETING, Dalhousie College, Feb. 9, 1880.

The PRESIDENT *in the Chair.*

Inter alia.

The PRESIDENT alluded to the death of PROF. DEMILLE, who had recently been elected a member of the Institute. He said :—

"I deem it a duty, melancholy though it be, to announce to you that by the recent decease of PROF. DEMILLE, after a short illness, the Institute has been deprived of another of its members, one of whom it may be truly said, that his loss will be deeply felt, not only by the Institutions of learning and Science with which he was connected, but generally by the community in which he lived. It is but little to say of PROF. DEMILLE that wherever he was known he was esteemed and respected. As an author he ranked high, and his works are very popular in the neighbouring Republic, where perhaps they are better known than amongst ourselves—his Rhetoric has become a text book in several universities. Although PROF. DEMILLE's more intimate connection with our Institute had been somewhat recent, I have good reason for believing that he took much interest in its proceedings, and that he attended its meetings as often as his more pressing avocations permitted ; and had he been spared I have no doubt whatever that his talents would have been freely exerted in its service. As it is there is only left to us to acknowledge, with humility, an afflictive dispensation which might not be averted by human wisdom and to add to the general expression our sympathy with his family in their bereavement.

It was resolved that this tribute te the memory of the deceased be inserted in the Records of the Institute.

DR. SOMMERS gave a minute and interesting account of the Anatomy of a Seal from the Magdalen Islands.

DR. HONEYMAN then read some remarks on the Geology of the Magdalen Islands, suggested by specimens of Rocks and Minerals presented to the Provincial Museum.

MR. FOX, who had resided on those Islands for twenty years as Collector of Customs, gave interesting information relating to the inhabitants and products.

Ordinary Meeting, Provincial Museum, March 15, 1880.

Robert Morrow, Esq., *in the Chair.*

Inter alia.

Specimens of the Corals, *Primnoa Reseda*, and *Paragorgea Arborea* were exhibited from the Museum collections. These had been found by fishermen in the Halibut fishery at Little Banquereau, north of Sable Island. They were regarded with peculiar interest as being Nova Scotian products.

Dr. Gilpin then read a long and interesting Paper, "On the Wild Ducks of Nova Scotia."

The Paper was illustrated by the extensive and beautiful collection of Wild Ducks in the Museum.

Ordinary Meeting, Dalhousie College, April 19, 1880.

The President *in the Chair.*

Dr. Sommers read some remarks "On a new Nova Scotia Trillium."

The specimen was found by Miss Godfrey, of Clementsport, Annapolis County, near the Victoria Bridge, Bear River.

Mr. Morrow then read the first part of an interesting Paper "On the Osteology of *Salmo Salar*.

The Paper was illustrated by carefully prepared skeletons.

Ordinary Meeting, Dalhousie College, May 10, 1880.

The President *in the Chair.*

Inter alia.

Dr. James Walker was elected an Associate member.

Mr. Morrow read the second part of his Paper "On the Osteology of the *Salmo Salar*.

Dr. Honeyman then read a Paper entitled "Notes on a new Geological Progress Map of Pictou County."

Adjourned until October next.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11. Akins, T. B., D. C. L., Halifax.
69. Feb. 15. Allison, Augustus, Halifax.
77. Dec. 10. Bayne, Herbert A., Ph. D., Professor of Chemistry, Royal Military College, Kingston.
64. April 3. Bell, Joseph, High Sheriff, Halifax.
64. Nov. 7. Brown, C. E., Halifax.
78. Nov. 11. Cockburn, Col., R. A.
67. Sept. 10. Cogswell, A. C., D. D. S., Halifax.
72. April 12. Costley, John, Dep. Pro. Secretary, Halifax.
63. May 13. Cramp, Rev. Dr., Wolfville.
75. Jan. 11. Dewar, Andrew, Architect, Halifax.
63. Oct. 26. DeWolfe, James R., M. D., L. R. C. S. E.
63. Dec. 7. Downs, Andw.. Corr. Memb. Z. S., London, Halifax.
71. Nov. 29. Egan, T. J., Taxidermist, Halifax.
74. April 13. Forbes, John, Manager Starr Works, Dartmouth.
72. Feb. 12. Foster, James, Barrister-at-Law, Dartmouth.
63. Jan. 5. Fraser, R. G., Chemist, Halifax.
73. April 11. Gilpin, Edwin, F. G. S., Inspector of Mines, Halifax.
60. Jan. 5. Gilpin, J. Bernard, M. D., M. R. C. S., Halifax.
63. Feb. 2. Gossip, Wm., F. R. M. S., *President*, Halifax.
63. Jan. 16. Haliburton, R. G., Barrister-at-Law, Halifax.
78. Dec. 9. Harris, V, E. Rev., Land and Mines.
63. June 17. Hill, Hon. P. C., Barrister-at-Law, Halifax.
66. Dec. 3. Honeyman, Rev. David, D. C. L., *Secretary*, Professor of Geology, Dalhousie College, Halifax.
74. Dec. 10. Jack, Peter, Cashier of People's Bank, Halifax.
79. Jan. 11. James, Alex., Judge of Supreme Court, Halifax.
63. Jan. 5. Jones, J. M., F. L. S., Halifax.
66. Feb. 1. Kelly, John, Dep. Chief Com. of Mines, Halifax.
77. Nov. 19. King, Major, R. A., Halifax.
64. Mar. 7. Lawson, George, Ph. D., LL.D., Professor of Chemistry and Natural History, Dalhousie College, *Vice-President*, Halifax.
75. Jan. 11. Mellish, John T., M. A., *Secretary*, Halifax.
72. Feb. 5. McKay, Alex., Principal of Schools, Dartmouth.
77. Jan. 13. Morrow, Geoffrey, Halifax.
66. Feb. 3. Morrow, James B., Halifax.
72. Feb. 13. Morrow, Robert, Halifax.
70. Jan. 10. Murphy. Martin, C. E., Provincial Engineer, Halifax.

Date of admision.			
1865.	Aug.	29.	Nova Scotia, the Rt. Rev. Hibbert Binney, *Lord Bishop of*
72.	Nov.	11.	Poole, H. S., F. G. S., Superintendent of Acadia Mines, Pictou.
76.	Jan.	20.	Power, Hon. L. G., Senator, Halifax.
71.	Nov.	19.	Reid, A. P., M. D., Superintendent of Lunatic Asylum, Dartmouth.
66.	Jan.	8.	Rutherford, John, M. E., Halifax.
64.	May	7.	Silver, W. C., *Treasurer*, Hollis St., Halifax.
68.	Nov.	25.	Sinclair, John A., Halifax.
80.	April	12.	Neal, W. H., Halifax.
75.	Jan.	11.	Sommers, John, M. D., Professor of Physiology and Zoology, Medical College, *Vice-President*, Halifax.
74.	April	11.	Stirling, W. Sawers, Cashier of Union Bank, Halifax.
79.	Feb.	10.	Twining, Chas. R., C. E., Halifax.
66.	Mar.	18.	Young, Sir Wm., Knight, Chief Justice of Nova Scotia Halifax.
77.	Jan.	13.	McGregor, J. G., M. A., D. Sc., Bristol, England, Professor of Physics, Dalhousie College, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
77.	May	14.	Burwash, Rev. Prof., Wesleyan College, Sackville, N. B.
75.	Nov.	9.	Kennedy, Professor, Acadia College, Wolfville.
78.	Feb.	11.	Louis, Henry, Assoc. Royal Sch. of Mines, London.
75.	Nov.	9.	McKinnon, Rev. John, P. E. Island.
65.	Dec.	8.	Morton, Rev. John, Trinidad.
76.	Mar.	13.	Patterson, Rev. George, D. D., New Glasgow.
80.	May	10.	Walker, Jas., M. D., St. John, N. B.

CORRESPONDING MEMBERS.

71.	Nov.	29.	Ball, Rev. E., Maccan.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
71.	Nov.	1.	Cope, Rev. J. C., President of the New Orleans Academy of Science.
70.	Oct.	27.	Harvey, Rev. Moses, St. John's, Nfld.
71.	Nov.	1.	King, Dr. V. C., Vice-President of the New Orleans Academy of Science.
71.	Oct.	11.	Marcou, Jules, Cambridge.
71.	Jan.	10.	Matthew, G. M., St. John, N. B.
72.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., London, Mineralogist to H. M. the Queen and the Baroness Burdett Coutts.
77.	May	14.	Weston, I. C., Geological Survey of Canada.

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I.—Nova Scotian Geology—Annapolis County continued.—By the Rev. D. Honeyman, D. C. L., *Curator of the Provincial Museum and Professor of Geology in Dalhousie College and University.*

(*Read Nov.* 10, 1880.)

INTRODUCTION.

About the middle of July last I resumed my investigations in the Geology of Annapolis county. My main object, however, was the investigation of the geological relations of the Iron deposits of Moose river. They have already been connected and correlated with the Iron deposits of Nictaux. Both have been assigned to the Devonian period.

I have in a preceding paper referred the Nictaux deposits to the Middle Silurian age *(Transactions, 1877-8)*, and for the time in a manner separated them from the Iron deposits of Moose river. I was prepared, however, for a reunion of both. The fact that the gigantic trilobite, *Asaphus ? ditmarsiæ*, was found in the magnetite of Moose river had led to the belief that it too was of Middle or possibly Lower Silurian age.

DIARY.

Tuesday, 16th.—On my way to Moose river I observed granites to the south of the Lawrencetown Railway station. This is almost due north of the approximate western limit of the Nictaux Iron bearing strata. From Lawrencetown onward to Annapolis the only rocks observed outcropping are granites.

I had an opportunity of observing the granites to a distance four miles south of Annapolis Royal. Through the kindness of one of Dr. Gilpin's friends we had a delightful carriage ride into the South Mountain. Reaching, apparently, the highest elevation on turning, the panorama beheld, on the north, was enchanting and extensive. The granite is known to extend 50 miles south of Annapolis. Dr. Gilpin has observed it thus far, and he believes that it connects with the Granites of Shelburne, on the Atlantic coast. This is important testimony, in its relation to the identity and age of the Annapolis and Shelburne Granites, as well as those of Halifax and other localities on the Atlantic Coast.

I found also a kind invitation awaiting me, from the Rev. Mr. Godfrey, of Clementsport, through his brother-in-law, Dr. Gilpin, offering me the hospitalities of the ' Rectory." This was found to include very efficient assistance in the prosecution of my most important investigations. I have also to acknowledge my obligations to Mr. Church, for a copy of his excellent map of Annapolis county, plain and unvarnished. This was of very great assistance in prosecuting and locating my work.

Wednesday, 16th, Dr. Gilpin took me to Moose River, by the South Mountain Road, a very rough, but admirable geological road. Here I had an opportunity of observing the transition from the granites to the stratified rocks, containing the Moose River Iron ores. We passed from the one into the other, about Beiler's Lake (Church's Map). The transition did not appear in outcrops, but from the contour, and the change from granite boulders, *debris* and roughness, to slaty, clayey and soft roads.

There were occasional outcrops of stratified rocks seen, before reaching the " New Mines" of Moose River (" Iron quarry" of Church's Map.)

At the New Mines were observed considerable excavations, all perfectly dry and fresh in appearance. Great piles of slaty material with *Magnetite*, were exposed, so as to be satisfactorily examined. Several hours were spent collecting specimens of fossils. Dr. Gilpin showed me the *situs* of the *Asaphus* ? *ditmarsiæ*, as indicated to him by the superintendent of the mines. The rock and the matrix of the *Asaphus* ? correspond, both being largely composed of *magnetite*.

We afterwards proceeded through the Valley of Moose River, observing numerous outcrops of rocks on the road side and in the river, and at length reached Clementsport, at the mouth of the River. I received a hearty welcome from the worthy Rector and his family. It surprised me agreeably to find, that my head quarters were beside the Iron works, and consequently convenient for work.

The same evening I went to call upon Mr. Ditmars, the collector of H. M. customs, and of geological and other interesting curiosities. As I expected of a collection, of which the *Asaphus? ditmarsiœ* was once a specimen, other objects interesting to the geologist formed a part, one of these was a large piece of *quartzite*, with a singular *cruciform* and other organisms. Mr. Ditmars kindly presented this very interesting specimen to the Provincial Museum. I shall yet refer to it in the sequel.

I was then taken to see the " Ditmars Falls." Here was observed, a fine exposure of metamorphic rocks and a really picturesque water fall. When the brook is well supplied with water, they are said to be somewhat imposing.

Thursday, 17th, the morning.—Examined the ruinous Iron works and the interesting section of rocks adjoining. The date of the erection of the Furnace, as seen from the keystone of an arch, was "A. D. 1831." The most extensive and useful part of the works that survives is the great dam and viaduct.

Forenoon.—Went with Mr. Godfrey to the " Old Iron Mines." at Milner's, (Church's map), traversed the same road which Dr. Gilpin and I travelled on the day before, a length of three miles. I examined the numerous outcrops of rocks, which I had already noticed in passing. Turning to the right we travelled upwards of a mile, crossing the extension of the Iron bearing rocks of the New Mines, without observing any outcrop of rocks. Turning again to the right, we travelled the Hessian Line road about three-quarters of a mile. We then walked in a northerly direction about a quarter of a mile, and reached the Old or Milner Mine.

No rocks were observed *in situ* from the time we left the Moose river road until we came to the Mines. I examined the old trenches, which are two in number, running parallel on two *beds* of ore, twenty feet apart.

These have the same course as the trench of the New Mines and are one or other doubtless a continuation of the Iron bearing strata of the latter. Fossils were collected, of forms similar to those of the *Asaphus? ditmarsiœ strata,* and others not found there. Returning we kept on the Hessian Line road until we reached the Moose river road, by which Dr. Gilpin and I came to the New Mine. I had thus an opportunity of examining the other outcrop already referred to, also of re-examining the New Mine and of adding to my collection of fossils. I thus found the Moose river road presenting a good cross section of the greater part of the rocks of the area under examination.

Friday, 18th, Morning.—Engaged in locating on Church's map the positions of the several outcrops examined, and in studying their relations.

Forenoon.—We went to Bear River Village, travelling the Digby Road at a distance of two and half miles; *Strata, deep* red and *soft* of considerable thickness, were observed and examined in "Deep Brook." Half a mile farther, on the left, we came to the Bear River Road, at the Temperance Hall and School House. Proceeding along this road we found an interesting outcrop of rock; just before reaching the summit of the mountain (Purdy's) other outcrops were observed, especially after reaching the road which follows the course of Bear River on the east. Outcrops were observed occurring very frequently between the cross roads and the village. Still keeping on the east side of Bear River, a short distance above the bridge, I found and examined an interesting outcrop of rocks, on the river side. The rocks are black slate with limestones, much metamorphosed and very hard. This is particularly the case with the limestones, which are fossiliferous. I could only get fossils out of them, where they were weathered, I collected some at the southern side of the outcrop, consequently in the lower *strata.* On the Digby county side of the river, the same *strata* are seen outcropping in a shipyard where a large ship was being built. Farther up the river we crossed at the bridge at Rice's mill; here we found a splendid outcrop of rocks, which at first sight seemed gneissoid, on closer examination they were found to be highly fossiliferous. I collected a few fossils and traced the outcrop southwards, until the rocks became obscure. Beyond, heights were observed with large granite boulders. In the village, on the Digby side, north of the bridge and below the wharves, another important outcrop of rocks was examined, on the road and riverside. Returned to Clementsport by the way we came.

Saturday, 19th.—Examined an interesting outcrop of strata at and north of the wharf, on the shore of Clementsport and opposite the Iron works; afterwards walked along the Moose river road to the New Mine, examining in succession and detail the outcrops of rocks already noticed, with a view to the proper understanding of the geology of the district.

Sabbath, 20th.—Attended service in Mr. Godfrey's churches, at Clementsport and Bear river village; went to Digby in the evening; attended services at Mr. Ambrose's.

Monday, 21st.—We travelled the road to Waldec, which branches from Moose river road, about half a mile from Clementsport; observed several outcrops of rocks similar to those exposed on the Moose river road, and examined the strata exposed in a deep brook at Waldec; proceeded to the mouth of Bear river and Digby road by the old post road, on which were observed interesting outcrops of rocks. Returned to Clementsport by the Digby road.

Tuesday, 22nd.—We returned to Bear river for the purpose of examining certain rocks exposed in a brook and on the river side about half way between Bear river village and the Victoria bridge; observed strata between the cross roads already referred to (Friday, 19th), and the rocks of which we were in quest. We found the rocks in the brook, somewhat obscured by *debris*, but collected fossils. On the side of the river we examined a fine clear section of the same rocks; collected fossils and also observed the rocks underlying. We returned by the road we came.

Wednesday, 23rd.—In the morning I went to the point, east side of Clementsport, with the expectation of finding *strata* exposed at low water. I passed over the beach, teeming with life searched for *strata* among luxuriant sea vegetation, and found only a great accumulation of rock masses and boulders, from the mountains on the north side of the basin (Annapolis). Under a pouring rain I made a collection of marine *fauna*, which lay in my way. I reached the rectory after a walk of a mile, wet enough. The rain was very much desiderated by the farmers, and upon the whole a rainy day was not very objectionable to myself. I had thus leisure to make up my notes, locate my work on the map, run my lines into, and even to forecast the geological arrangements of Digby county, especially on the coast of Saint Mary's bay, to await confirmation in another season.

Thursday, 24th.—I proceeded to revise and complete the Moose river section by making probable additions, whose existence was inferred from occurrences at Bear River, *i. e.*, I expected to find the extension at Moose River of the fossiliferous rocks, found above the Bear River Bridge and Rice's Mill.

Friday, 25th.—About a mile S. E. of the New Iron Mine we found a fine exposure of the rocks sought for. From this outcrop to a sawmill on the west branch of Moose River, $1\frac{1}{4}$ miles, nothing was to be seen but the *evidence of Granite* i. e. a change of *contour*, granite *debris* and boulders. Under the guidance of Mr. Godfrey, I believe that I have examined every important exposure of rocks in the district. The whole area traversed is $7 \times 5\frac{1}{2}$ miles = 38 square miles. The greatest width of the strata examined seems to be from Digby to some point west of Bear River, along the line of strike of Bear River strata, being 5.5 miles. Along Bear River, the width is 4.3 miles ; along Moose River and road extension, 4.3 miles (the measurements are according to Church's map.)

PETRA.

1. *Granites.*—We have seen that the stratified rocks of the region are bounded on the east and south by granites. The granites are a continuation of those of Nictaux, and the same as to general character and age, i. e. in age they are Lower Cambrian Archæan with Lower Silurian alteration. Here they have not been observed in contact, or even in close proximity to the strata as at

Nictaux; consequently this element has not been available in the matter of mutual correlation.

2. *Gnessoid rocks.*—Dr. Gilpin informed me of the existence of gneissoid rocks in the Granite Mountain, south of Annapolis, not far from the point of Panorama, (Diary Tuesday.) Since then he has given me specimens of the rocks referred to. They correspond with the gneissoid rocks at Nictaux and are doubtless of the same age, (Lower Cambrian). Masses and boulders of similar rocks were observed in the region of Moose River. Some of the masses looked as if they might be *in situ*, but they were evidently transported. It is possible that the rocks may intervene between the fossiliferous quartzites of the extreme south of Moose River section and the granites, without making their appearance by outcrops.

3. *Diorites.*—As at Nictaux these are of frequent occurrence. The greatest exposure of Diorite (1) is on the Digby side of the Bear River, (Victoria) Bridge. This may be regarded as the first of the Bear River section of rocks. Diorite (2) was observed on the Old Post Road near Bear River. (Diary, Monday). Diorite (4) is near the summit of Purdy's Hill. (Diary, Tuesday.) Diorite (5) is on the Moose River road about a mile and a half from Clementsport. Diorite (6) is on the same road section about an eighth of a mile from the preceding. Diorite (7) is about a third of a mile from Diorite (6), and at the lower end of Bear River Village. (Diary, Thursday,) at a distance of about three and a half miles from Diorite (1), at Victoria Bridge. It is not far below the extension of the strata of the New mines in the same locality. If this Diorite 7 were to be extended to Moose River its position in the section would not be far to the north of the New mine. If the others were in like manner to be extended, we should have Diorites occurring in the section the same number of times as in the Nictaux river and Cleveland mountain section.—*Vide Paper.*

4. *Quartzites and Sandstones.*—The Quartzites which seem to be *first* in order are exposed on the Annapolis side of Bear river, about one-eighth of a mile from Diorite [1] (Diary, 2nd Tuesday.) Mr. Godfrey informed me that an attempt had been

made to improve the river road, which is certainly very steep where it passes over this quartzite and its associate rocks, but had to be abandoned on account of the hardness of the rocks. The outcrop on the river certainly indicates considerable thickness and flinty hardness. The *second* quartzite is exposed at T. Bogart's, in great masses on the east side of the road. The road makers seemed to have shunned this. It is of equal hardness with the preceding. It occurs 1.1 miles from it. The *third* quartzite is at Rice's mill. This is fossiliferous (Diary, Thursday, 17th.) It is more like a sandstone. It is metamorphic, but not in the same degree as the two preceding. It has cleavage, but is of inferior hardness. Its extension is at Moose River, which is also fossiliferous (Diary, Thursday, 24th). This is highly metamorphic and of equal hardness with Quartzites (1 and 2):

5. *Micaceous Slate.*—A thick band of highly micaceous and black slate succeeds the *first* diorite (3) of the Moose River road section. The outcrop of this is very striking. It looks like roofing-slate, and divides very regularly into rhomboidal forms. When split, the surfaces are coated with scales of mica, giving an unctuous touch.

Another micaceous black slate was observed in connection with the great quartzite of Bear River.

These slates very much resemble the micaceous strata of Nictaux Falls, except in compactness. As this properly may be viewed as accidental, the resemblance may be regarded as indicating the co-temporarity of the Nictaux slates, which I was led to regard as of *age prior* to the strata with which they are associated. *Vide Paper in Transactions.*

STRATA.

Argillites.—In describing these I shall sketch the Moose River section.

1st.—We have the red and grey strata north of the wharf of Clementsport. The same appears in sections on the Digby side of Bear River, at the Victoria Bridge. This is above diorite. (1.) They are also seen in Deep Brook, at Ditmars farm, between Victoria Bridge and Clementsport. Here they extend from the post-road to the beach of Annapolis Basin. They are all very red, so much so that when ground they may be used as *red ochre.* Part of the strata of light colour are said to act like soap when used in washing. The softness of the band and its position leads to the inference that it has suffered very much from denudation in previous periods as well as the present. It doubtless added its *quota* to the formation of the New Red Sandstone (Triassic). Its colour should be taken into account on speculations "On the colouring of the New Red Sandstone" of Annapolis and Kings Counties. I have already credited a part of this colouring to the *Red hematite* of Torbrook, Nictaux. The red slates of Kentville and Wolfville should not be overlooked. In the outcrop at Clementsport the red and grey argillites have interbedded quartzites and quartz veins, the latter attaining to a thickness of three inches. Following these are slates of various shades of grey and black, on them the wharf is built.

The next in order are the strata of the Iron works on the other (E.) side of the harbour. These extend as far as the Bridge according to the outcrops. They are highly metamorphic, having slaty cleavage joints. They are very hard, micaceous and crumpled. Their colours are grey and black.

Beyond the Bridge are the slaty strata of Ditmars Falls (Diary Wednesday). On the road the outcrops of these are often bold cuttings. This is especially the case at the beginning of the road to Waldec. About a seventh of a mile beyond the Bridge a fine outcrop is seen in the river. They present a beautiful banded appearance, and are very hard. After this comes the micaceous slate, already described. Beyond these, after an obscure interval we have the slates of the New Mines, also described. These extend to Milner's Mine, westward they outcrop on the Annapolis side of Bear River, and also on the Digby side above the Diorite. As the quartzite with fossils, at the end of the Moose River section, has been shown to be the extension of the Fossiliferous sandstones at Rice's Mill, Bear River, we may assume that the outcrops extending between New Mines and the Quartzite are of strata, which are the extension of the fossiliferous strata between Rice's Mill and Bear River (Village) Bridge. I think that I may also assume the Bogart's Quartzite (No. 2), Bear

River, extends eastward to the north of Milner's Mine, and may even be concealed in the obscure interval noticed in the Moose River section. My additional reason for supposing its existence near Milner's is, that the specimen of quartzite containing the singular forms already referred to (Diary Wednesday), as received from Mr. Ditmars, was found there. On comparing the specimen with others from Bogart's quartzite, I find that they are *identical* even in *accidental structure*, such as quartz veins. The position of this quartzite relative to the *Asaphus? ditmarsiœ* strata, according to this analogy, will be about a quarter of a mile north, and therefore (geologically) considerably *lower*. Supposing the former to be of Middle Silurian, the latter may be assigned to the Lower Silurian period.

There is considerable variety in the strike and dip of the strata of the area.

The red slates in Deep Brook (Ditmar's) have a strike N. 55 E., S. 55 W., and a vertical dip.

The red and grey slates of Clementsport have a strike N. 60 E., S. 60 W., and a dip of 43 S.

The strata of the Iron works have a strike N. 55 E., S. 55 W. and a dip S. 51 S., also a strike N. 40 E., S. 40 W., and a dip 40 N. They seem to be folded.

The same below the bridge at Moose River have a strike N. 45 E., S. 45 W., and a dip 48 S.

The strata in Moose River have a strike N. 60 E., S. 60 W., and a dip 65, S. 30 W.

The strike of the micaceous slates in the vicinity of Diorite (3) is N. 75 E., S. 75 W., dip 74°.

The strata of the outcrop of Purdy's Mountain, (Diary Friday) have a strike N. 50 E., S. 50 W., and a vertical dip.

The black fossiliferous slates of the outcrop in Bear River, above bridge, have a vertical dip, and also a dip 68, N. 30 W.

The fossiliferous sandstones of Rice's Mill, Bear River, have a strike S. 60 W., N. 60 E., and a vertical dip.

The formation of these crystalline Diorites here, as elsewhere, e. g., and East River, Pictou, and Nictaux, Annapolis, have been the cause of the prevailing metamorphism and disturbance of the stratified rocks. Two of the Diorites present the same phenomena at their point of contact with the strata, as are found in the localites specified, coalescensc as if from contact while the Diorites were in fusion. There is in fact a blending of the crystalline and uncrystalline rocks. To the same cause the peculiar condition (magnetic) of some of the bedded ores is also to be assigned.

Quartzose and Micaceous.—This seems to indicate in a peculiar manner the origin of the strata as well as their relation to the associated rocks. The material has such a granitic character as to impress the conviction that it has been derived from the associated granite. It thus teaches the same lesson as the *condition* of the uncrystalline rocks in contact with granites at Nictaux.—*Vide Paper on Nictaux, Transactions, 1877-8.*

Red and gray argillites of the Moose River section, Bear river and Deep brook, seem to throw light on the geological relations of similar strata at Wolfville and Kentville. Here we have palæontological aid, which was much desiderated, especially at Wolfville (*Paper in Transactions, 1878-9.*)

FAUNA.

Coelenterata.

Corals.

1. *Stenopora.*
2. *Petraia sp. ?*

Annuloida.

3. *Crinoidea.*

Annulosa.

4. *Cornulites flexuosus.*
5. *Beyrichia 2 sp.*

Trilobita.

6. *Asaphus ? ditmarsiæ.*
7. *Dalmanites gilpini.*
8. *Calymene ?*

Mollusca.

Brachiopoda.

9. *Strophomena alternata.*
10. *Athyris sps.*

11. *Spirifera sps.*
Lamelli branchiata.
12. *Modialopsis sp. ?*
Gasteropoda.
13. *Pleurotomaria ?*
14. *Maclurea ?*
Heteropoda.
15. *Bellerophon trilobatus.*
Pteropoda.
16. *Theca sp.*
17. *Tentaculites sp.*
Cephalopoda.
18. *Orthoceras ?*
Incertæ sedis.
19. *Arthrostauros godfreyi.*

Notes on *Fauna.*

2. *Petraia sp ?* This coral is small, having a diameter 10 m. m. It seems to be a cast of the top of the calyx. The *septa* are numerous, being distinct around a fourth of the circumference, where the number is twelve, making a total of 48. A *carapace* valve of a *Beyrichia* covers the half of it.

5. *Beyrichia 2 sps.* These are numerous. We have *Carapace* valves of at least four distinct forms, representing, possibly, *two species.* At Nictaux two indistinct valves were found which were supposed to resemble *Beyrichia kloedeni.*

Here they are decidedly different and undetermined.

6. *Asaphus ? ditmarsiæ.*—This trilobite, which I described and named in the last year's *Transactions,* is one of those giant forms which appear and culminate in the Lower Silurian, and survive to the middle or intermediate Silurian period. Its bedding here is *magnetite.*

7. *Dalmanites gilpini* is also from the mines, of this I have only a *globella.* This however is in good preservation. It is broken off at the *occipital* furrow. From this to the front, the length is 19 m. m. This is equal to the width of the *frontal* lobe. The width of the *anterior* lobes is 16 m. m. of the *median* 14 m

m. of the *posterior* 12 m. m. There is a deep *fossette* on the back part of the frontal lobe, a little above the anterior furrow. It is *papillose* or coarsely granular except in the space between the lateral furrows, there being only two tubercules from the curve of the fossette to the occiput. All the species that have been found in the "Upper Arisaig series" with the exception of *Dalmania logani* occur in B, or Clinton, none of them are papillose. Regarding the species as new, I have named it *Dalmanites gilpini*.

9. *Strophomena alternata* does not occur in our "Upper Arisaig series," but it is of frequent occurrence in the "Wentworth series" of the Cobequid mountains, which I have correlated with the Hudson river or Cincinnati period (Lower Silurian).

10. *Athyris* of several species are found in the forms of casts. This *genus* prevails in the lowest part of the "Upper Arisaig series," being generally associated with corals, which were referred to the genus *Petraia* by Mr. Salter. The *Athyris* then disappears to reappear in great force in the Lower Carboniferous Limestone.

11. *Spirifera* are abundant here as at Nictaux, especially in the Iron mines. It is the prevalence of *Spirifera* that makes me hesitate in placing the *Asaphus ? strata* lower than the middle Silurian. In the "Upper Arisaig series" Spirifera are most numerous in the Middle Silurian division.

14. *Maclurea, s. p.*—The form which I referred to the genus Maclurea, occurs in the specimen of quartzite referred to in my Diary (Tuesday, 15th) associated with the *Cruciform* organism. It is a cast of the top of the shell or *whorl*. The width of the cast is 2.7 x 2 inches, its depth, .7 inches.

15. *Bellèrophon trilobatus.* Several specimens of this *Heteropod* were found at the mines. It differs from the *Bellerophon trilobatus* of Arisaig in the form of its middle lobe. It is not so rounded, being rather acute, so that it may be regarded as an older variety. *Bellerophon trilobatus* is not found in the Middle Silurian of the "Upper Arisaig series." Its first appearance is in its *crinoid* strata, at the base of C, the Upper Silurian.

16. *Theca, sp.* is very much like *Theca triangularis* of the

Upper Silurian. This is its first occurrence in Nova Scotia, away from Arisaig. It appears to be a *prior* occurrence.

17. *Tentaculites, s. p.*—This is a small *species* like that of B, "Upper Arisaig," Middle Silurian.

19. *Arthrostauros godfreyi.*—This is the *Cruciform organism,* associated with *Maclurea.* Its obvious form is that of a Roman cross, not altogether straight in the body, the lower part of it being bent to the left. It is jointed. The number of joints is eleven. The ninth has two branches or arms of equal length proceeding from it in opposite directions. The right one has a tendency upward, not being altogether at right angles to the straight part of the stem. The joints are compressed bead-shaped, and are generally half an inch in diameter. The only form that I have seen figured, which has any thing in common with it, is the *Arthroclema pulchella,* Billings. Of this the joints are differently shaped, and the branches are more numerous. While *Clema,* signifying *a twig,* is sufficiently appropriate as representing the shape of the latter, *Stauros* is more appropriate to the specimen before us.

The *Maclurea and Arthroclema* are Lower Silurian forms in Canada.

Localities.

The localities in the Moose and Bear rivers area, having fossils are: 1st, the New Mines. 2nd, the Old Mines. 3rd, Beaver river above the bridge and at Rice's mill. 4th, the continuation of Rice's mill strata, at Moose river. 5th, Bear's river midway between the Village bridge and Victoria bridge.

Inferences.

We are thus led to the conclusions—

1. That the *magnetyte* strata of Moose River are not newer than the Middle Silurian Period.

2. That the Quartzites at Bogart's and their eastern extension are of Trenton, if not Calciferous, age.

I have already on lithological considerations, regarded the great quartzites of Gaspereaux River, Kings County, and their associated argillites as possibly of Lower Silurian age.—*Transactions 1878–9.*

Palæontological evidence was in the case of these quartzites and argillites much desiderated. The *Maclurea* and *Arthrostauros* of Moose River may be considered, in a measure, as supplying the *desideratum*.

Certain quartzites and argillites, in Cleveland Mountain, Nictaux, may be included in the same category, as well as other quartzites at Beaver River, *e. g.*, at the joint locality No. 5.

CÆTERA.

I searched for Triassic strata resting on the red and grey strata, as at Wolfville and Kentville, but did not find any. The only formation met with was post-pliocene drift and clays. Red and tough clays were found on the shore and river banks. On the sides of Moose River were observed sections of lofty red banks of drift. In these were abundance of boulders from the North Mountain. Boulders of Basalt and Amygdaloid were found scattered everywhere. Great granite masses were also observed transported from the granite region on the east or south.

Cambrian gneissoid boulders and masses were also found as far north as Clementsport. One mass on the road from Moose River to the Milner Mine, (Diary, *Thursday*), was so large as to seem *in situ*. The original rocks were not found. They may lie concealed on the borders of the granite region, as this was their position at Nictaux.

At Lawrencetown we have observed that the South Mountain presents a granite front. Behind this the Mountain continues to rise, including the extension of the Nictaux stratified rocks and diorites, wedged between the Lawrencetown and New Albany granite.—(Vide previous paper, Trans. 1877-8.)

Succeeding are the granite heights of Paradise, from which proceeds its river to join the Annapolis river. As Annapolis is approached the South mountain with its granite, and the North mountain with its traps, converge; the valley narrows and the Annapolis river widens into the French and Annapolis Basins. Between these lies Annapolis Royal on a peninsula.

Its Triassic strata, if such there be, lie concealed; no outcrops appearing all around to give evidence of their existence. The Archæan granite and Triassic Traps are only evident. The two periods, separated by time of duration inconceivable are thus in space, brought into close contiguity.

From Annapolis the Basin begins to widen, and the mountains to separate. The route is continued along the south side of the Basin over the Border skirting the granite rising ground and mountains on the south, which at length abruptly terminate and retreat, to make room for the area of stratified and igneous rocks which has been examined.

Approaching Clementsport the flat border is widened and becomes on the east side of the port, an area with farms of considerable extent adorned with large and elegant houses.

On the back of this area the ground rises—the soft, red, grey and black slaty strata, as I have observed, being succeeded by the hard strata of the Iron Works. The Episcopal Church is seen crowning the height, while the Rectory is seen peeping out among the beautiful trees on the less elevated ground below.

From the Rectory front through an opening among the acacias, pines and fruit trees, the prospect is beautiful. The port and mouth of Moose River, with its village, wharves and wood crowned heights, are seen extending into the basin, whose wide expanse is bounded on the north by the North Mountain. Over the woody point on the east side of the river mouth Digby town is well seen, and its wonderful mountain gap (Gut) which opens into the Bay of Fundy. The inmates of the Rectory, with the aid of a neat little *Dollond* spy-glass, are able to render the view still more interesting by bringing the distant mountains nearer, by seeing steam boats and ships on their way to and from Annapolis, and by bringing Digby, its churches, residences and inhabitants within sight of the observer.

Going from Clementsport to Bear River the flat and fertile border is still farther traversed.

At Mr. Ray's farm it has its greatest width, his elegant residence seeming at a great distance. The width here is little short of a mile. A great beauty is the abundance of cherry trees with a good crop of cherries. This is the introduction to a celebrated product of this part of Annapolis and Digby counties.

The story of the early settlement of the district is interesting

A few Refugees—four in number—had all the flat country between Clementsport, as a grant, and part of the hilly region extending to the distance of a mile from the shore. The back hills were afterwards granted to disbanded German soldiers. Hence we have the names Waldec and Hessian Line in the mountains. It appears that a feeling somewhat akin to Jew-Samaritan prevailed between the two classes of settlers.

On the road to Bear river village which turns to the south of the main road, an ascent is made into the mountain. Near the first summit the outcropping rocks diorite, quartzite and slate indicate the origin, age and constitution of this part of the mountain, and its continuation. From this elevation and various parts of the mountain road (Waldec), which runs on the tract and ridge of the mountains, a panorama to the north, north-east and north-west of Annapolis, the Basin, North mountain, Digby, its gut and neck, with St. Mary's bay is truly enchanting. The mountains of course have their valleys, the rocks outcropping in the brooks, in these, account for their existence.

The road on the east side of Bear river, half way between the village and mouth of the river, presents a lovely view. The river somewhat broad winds beautifully on either side, it is mountainous, the heights over the quartzite with its fossiliferous argillite rise abruptly, covered with forest, the long Victoria bridge is seen spanning the river near its mouth, beyond which is a part of Annapolis basin ; North mountain closes the view.

Bounding the south side of the district is a long valley, behind which rises parallel after parallel of mountains, which seem to be granitic from the all prevailing spread of granite masses and boulders, without any other work appearing, or are seen to be granite from the prevalence of solid granite.

At the Bear River end of the great valley, Clements Vale, and the bounding mountain parallel, is situate Bear River village. This village is remarkably beautiful and picturesque, It is set on either side of the beautiful river, among hills of considerable eminence. It belongs to two counties—Annapolis and Digby. It has its wharves, drawbridge and shipyard, and is the seat of considerable trade. A large and beautiful barque just launched, lay at one of the wharves alongside of piles of lumber. This was associated with other vessels. In a shipyard above the bridge another barque was on the stocks. This shipyard is a place of Geological interest. The ship stands on one of the outcrops of fossiliferous rocks already referred to. Its numerous churches and elegant houses are worthy of notice. A great charm is the prevalence of ancient and noble oaks, and great, beautiful and productive cherry orchards. The last was an important element in the pleasure of our visit. It was cherry time—there was bustle in cherry picking for export, and local enjoyment. The following Sunday was "Cherry Sunday." Visitors from distant towns and villages were expected to aid the robins, who were remarkably numerous and busy in enjoying and disposing of the cherries. Bear River is evidently a paradise for robin.

ART. II.—GEOLOGICAL WAIFS FROM THE MAGDALEN ISLANDS.—BY REV. D. HONEYMAN, D. C. L.

THESE islands are situate in the gulf of St. Lawrence, between long. 61° 23′ and long. 62°, and lat. 47° 13′ and lat. 47° 52′.

They have a trend N. 45 E., S. 45 W, corresponding with that of Nova Scotia and Cape Breton.

Amherst islands, Grindstone island, Entry island and Allright island, the south-west islands of the group, are all peculiarly elevated according to the Admiralty charts.

In Logan's Geological Map of Canada the formation of the island is indicated as Lower Carboniferous.

My attention has been specially directed to the Geology of the Magdalen islands, by specimens brought from time to time to the Provincial Museum.

1.—I received, three or four years ago, two pretty large specimens of Manganese ore, Pyrolusite, from Mr. William Johnstone, of Halifax. These are identical in character with our specimens from the Lower Carboniferous Limestone of Hants, N. S., Teny Cape, N. S., and North River. Colchester, &c. From these I was led to infer the existence of Lower Carboniferous Limestones in the Magdalen islands, having Manganese.

2.—Specimens of Gypsum were subsequently received from Mr. John Boak, of Halifax. These are of character and quality identical with the Nova Scotia Lower Carboniferous Gypsums.

3.—Lately other specimens were received from Mr. John Tucker, of San Francisco. There are, first, a specimen of coarse agate, with cavities containing quartz crystals. Second, three beautiful jasper specimens, blood red, green and yellow.

These are all from Grindstone island; and are evidently trap minerals.

From these observations we are led to infer that the Magdalen islands are of some geological importance and its minerals of possible economic value.

Their geology appears to indicate the existence of an enormous submerged area of Carboniferous strata lying between Gaspe, Canada, and Port au Port, of Newfoundland, extending to Cape Breton, Nova Scotia and New Brunswick.

On a part of this Prince Edward Island's Triassic Sandstones seem to rest.

Mr. Fox, the collector of customs, who has been a resident of the island for twenty years, informs us that the elevation of Amherst island, Grindstone island and Entry island is from five hundred and six hundred feet; that trap is prevalent, on these islands, that one of the specimens is undoubtedly derived from this.

The first looks like a specimen found in situ; the others may be transported boulders.

The Jasper pebbles are identical with some that I received about six years ago, with beautiful agate pebbles, from Gaspe bay, which lies to the N. E. of Grindstone island.

The Gaspe pebbles are thus referred to in Logan's Geology of Canada, 1863, page 404:

" Associated with these are others (pebbles) as of agate and of red yellow and green Jaspers, often brilliant in colour, which have probably been derived from the Conglomerates of the Gaspe Sand stones. These Jaspers and agates are known among collectors as 'Gaspe pebbles.'" Of course the conglomerates in this case can only be regarded as the secondary source of the 'Gaspe pebbles,' just as the Carboniferous Conglomerates of the Cobequid mountains in Nova Scotia are the obvious secondary source of many of the rounded boulders and pebbles of Syenite, Diorite and Porphyries which are found in our post pliocene drift.

The Jasper pebbles are supposed to come from the post-pliocene, so that they may have come from Gaspe.

Gypsum was once an article of export to Canada. It is not now exported ; Nova Scotian Gypsum is preferred.

ART. III.—ON THE SEMI-ANNUAL MIGRATION OF SEA FOWL IN NOVA SCOTIA.—BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read March* 15, 1880.)

IN this paper I wish to call the attention of the Institute to that part of the great semi-annual migration of sea fowl which passes the whole eastern coast of North America, belonging to the coasts of Nova Scotia; of the separate genera and species of which it is composed; of the monthly periods of their passing; and of the modifications both in time, in frequency and in species, which advancing civilization has produced. From the earliest writers and voyagers, not only along the New England coasts, but also of our own Province, we notice mention of these migrations, and are amazed by their numbers, darkening the air and blackening the shores along which they passed. With no enemy save those natural ones, which the economy of nature always provides, they passed north and south without fear or molestation. For the last three hundred years an advancing population at almost every point on their passage, from Labrador to Florida, has thinned their numbers, altered their route, and perhaps, in one or two instances, changed their route entirely or destroyed a species. The small part which the shores of our Province of Nova Scotia take in these migrations, or indeed the still smaller part that has come beneath my own personal observation, aided by one or two friends, will be the subject of this paper.

List of water fowl and sea fowl personally noticed in Nova

Scotia. Nomenclature of Dr. Coues, *Key.* North American Birds :—

Branta	leucopsis,	Barnacle goose.
Branta	bernicla	Brant.
Branta	canadensis,	Wild goose.
Anas	boschas,	Mallard.
Anas	obscura,	Black duck.
Dafila	acuta,	Pin tail.
Mareca	americana,	Widgeon.
Querquedula	netion,	English teal.
Querquedula	carolinensis,	Green-winged teal.
Querquedula	discors,	Blue-winged teal.
Spatula	clypeata,	Shoveller.
Aix	sponsa,	Wood duck.
Fuligula	marila,	Scaup.
Fuligula	affinis,	Little Scaup.
Fuligula	collaris,	Ring-neck duck.
Fuligula	valisneria,	Canvas back.
Buchephala	clangula,	Golden-eye.
Buchephala	islandica,	Barrow's Golden-eye.
Buchephala	albeola,	Buffle-head.
Harelda	glacialis,	Old wife.
Camtolæmus	labradorius,	Pied duck.
Histrionicus	torquatus.	Harlequin.
Somateria	mollissima,	Eider.
Somateria	spectabilis,	King Eider.
Oedemia	americana,	Scoter.
Oedemia	fusca,	White-wing.
Oedemia	perspiliata,	Surf duck.

Of this list of fourteen genera and twenty-seven species we find that nine genera, with the exception of the genus Aix, and one species obscura of the genus Anas, are more or less rare. Appearing in some years tolerably numerous and then for years not seen. I have never seen myself or heard from others of any Swans being seen in our Province. Of Geese, I had sent me from Sable Island, in the year 1870, an immature specimen which I put down to Leucopsis, especially from the dark line running through the eyes and on the nape of the neck, the dark wing coverts, and black bill and feet. In 1874, I saw two specimens of the same shot on Halifax common, and in the collection of my friend, Mr. Downs, who considered them the young of the snow goose. With every respect for one who may be called the best field naturalist in the Dominion, I cannot reconcile the black bill and legs with Wilson's description of the pale lake or reddish purple of the bills and feet of the young snow geese shot on the Delaware River, and must maintain my opinion. These are the only specimens I have seen.

Of the Canada goose, his migrations may be said to be regular in the Spring. From after the middle of March to about the middle of April, numerous flocks pass over the land, going north-eastwards, and scattered parties, of half a dozen or more, are found feeding along the shores of the tide ponds and salt estuaries of the Bay of Fundy, the Atlantic coasts, and especially the shores of Cape Breton. Should heavy north-easters prevail these flights are driven down in numbers to the land, and thus every few years wild geese are plentiful in Halifax market during April. I have noted 10th April, 1879, one being shot at Digby, near the Bay of Fundy. The Brants also pass about the same time of Spring, but are less noticed, except during a long period of foggy weather, when they seem bewildered, and cover the flats in hundreds and are easily shot. The autumn migration of the geese and brants is less noticed. I have no notes of their alighting, but several of the peculiar note of the wild geese heard in October, November, and indeed midwinter. During one Spring, about 1870, the brants remained about Digby, N. S., till the middle of May, becoming very fat though arriving very lean. That these geese, as well as the snow goose, once bred in numbers on the salt marshes of Annapolis County, and that their habits have been altered by advancing population, is well proved by old writers. The early French writers notice the abundance of "outards," both white and grey, that bred on the Port Royal marshes, the white being no doubt the snow goose; and those bred from wild eggs, and carried to France as a royal present, still existed in their decendants, which thronged by hundreds, in Buffon's time, the royal waters of Versailles, as the " A Canadensis." There are people still alive who recollect that the Brants bred in abundance in St. Mary's Bay when they were children. I scarcely need say that none are found breeding there now, or scarcely alighting, except in some years. This power in the individual bird of prolonging its existence by altering its breeding grounds must perpetuate its race, whilst other races having attachments stronger to one place have died out, and are still, during our own time, diminishing.

Of the next family of true duck or fresh water fowl, with the exception of the black or blue wing duck, and wood duck, which curiously enough, are resident, consisting of the mallard, pintail, widgeon, the teals and shovellers, they may be said to be rare; never to abound in market, to appear during fall and winter, and chiefly to be found in private collections or in note books of naturalists. Thus I note " Mallard, young male, no white collar, shot Sept. 1875, Cole Harbor, near Halifax—J. M. Jones." Pintails rather more numerous. Halifax Museum, Young collections,—Mr. Downs and Mr. Egan, males full plumage. Of the teals, blue winged, male full plumage, shot Jan'y; 1880, Halifax; green winged teal, Halifax market, 12 Dec., 1871. male, full plumage, myself; English teal, (Q. netion), very rare, mounted by Mr. Downs, with American, to show the difference of species; widgeon, female, full plumage, Jan., 1880, Halifax, Mr. Egan; and a shoveller, exceedingly rare, shot at Digby by my son; and shot, April, 1879, Halifax, male in full plumage. Mr. Egan. From these extracts we find this family rare in individuals, and occurring during winter sometimes, and then in full plumage. Whilst those birds thus make our Province a casual visiting place, it is singular that the blue-winged duck, a true type of the fresh water duck, with its long and low bill, slender neck, legs brought forward, a poor diver but good walker, so closely allied to these genera in all these respects, should be a resident, in company with the wood duck, nearly as closely allied also, yet it is so. Down in the salt marshes bordering the river mouths, just above tide way, we find him nesting in May. In August, the mower with his scythe cuts the young brood scarcely able to fly. At the same time others are nesting along the rush-fringed sides of our inland lakes, and the young are protected by their mother seeking their food in the shallow rapids. In 1854, I found them nesting on the low banks of the salt lake or lagoon which makes the centre of Sable Island, some eighty miles seaward from the Province. The nests were very inartificial, more like the circular folding or twisting of the long grass by the duck's body and legs with a few scattered feathers. The eggs were a light bluish green and about ten in number. Whilst in June I saw the mother duck leading her young flock on the lake, I have seen others sitting patiently during the last of July on, perhaps, a second or third robbed nest. If undisturbed they would doubtless remain on these salt marshes till the ice drove them out. Disturbed by sportsmen, they seek the lakes. In September they are found feeding upon the blueberries covering our barrens, and as winter advances, and the frost drives them, they return to the salt marshes, and at last, in deep winter, to the bays of the ocean; thus returning to marine molluscs that furnished their first food. In deep winter he is found nestling beneath the snow, waiting for the ebb tide to bare the rocks from which, being no diver, he collects his scanty supplies of frozen molluscs. On Sable Island he remains as long as the salt lake keeps open from the ice, but returns in the early Spring. This duck may be called both resident and abundant in the Province. Although often and long ago described, yet I cannot forbear describing again a male in full plumage shot at Digby, N. S., 9th February, 1880:—

' In colour, top of head obscure line running down back of neck; shoulders, upper back axillaries and wing coverts blackish, but as almost every feather had its edges brown, the general appearance was brownish. On the top of the head the brown appears in lines, on shoulders and other parts as scales, the lower back and rump black, the tail sooty black, but each feather emarginated. The primaries sooty black, the secondaries having a speculum of blue with purple reflections, bordered above with velvet black and edged with greyish white; the tertiaries having the outside edges velvet black. Beneath the colour and shading of feathers like the upper parts, but lighter. Edge of shoulder spotted black and brown. The upper part of inside wing pure white, but shading off to bluish ash, darker towards the extremities; beneath tail, dark ash. Returning to the head, there is an obscure line passing from behind eye to back of head. All below the eye, the cheeks, the chin, throat and sides of neck, for about four inches, may be called very pale fawn, as a back ground to numerous dark pencilled dots or lines. In the full nuptial plumage of the male, the border between this lighter neck and the deep brown of the breast becomes very distinct, indeed, with his pouting cheeks, swelling neck and tumid feathers, he looks as if he had an ashey white neck and head. The female and young are less distinctly marked. The bill is long and low, the frontal feathers coming down in a peak, the side feathers in a semi-circle. The colour of the bill is greenish horn with the tips black and a subcircular nail on each tip. The lammella very fine in both mandibles; the nostrils high up. A line runs along the upper mandible from rictus to tip, and a second line above this, from the tip, passes it. The legs are a dusky orange, with a red wash; the webs scarcely black; the soles dusky. The tarsi and toes are uninterruptedly scutellated on their front; on other parts, obscurely reticulated.

"Total length, 2 feet.
Length of spread wings, 3 feet 3-10 inch.
" of upper mandible, $2\frac{1}{2}$ inch.
" of tarsus, 2 inch.
" of longest toe, $2\frac{1}{2}$ inch.
Irides, dark brown.
Tail feathers, 16—"

In some young birds shot 1st August, 1880, and still in fine feather, the plumage was much darker than adult, and less diversified by fawn or brownish edges to the feather. The other resident duck we have, cannot be called abundant. Unlike the last sombre-coloured but still very beautiful bird, he is adorned by the most beautiful metallic tints of the tropics, and seems an alien upon our frozen streams. Of the wood ducks breeding here, I have had several specimens of the young, shot August 17th, 1877, near Annapolis Royal, in their first plumage, and not having the white-forked collar of the adult. The Indians all maintain he is found mid-winter about the rapids and low falls between our inland lakes, which never freeze. This has been confirmed by sportsmen, and also lumberers, who camp all winter beside these streams, yet he seems out of place, and I fancy not abundant or long to remain. I have never seen him in winter myself. Our next group of ducks, consisting of the Scaups, the Ringnecks, Canvasbacks, the Goldeneyes and Buffleheads, stand immediate between the freshwater and the sea ducks. They are at home equally in lake and ocean. They are expert divers but bad walkers, having the leg thrown far back. Their bills have become short and high, their forms more robust, necks shorter, and bodies losing the long oval form of the typical black duck, and becoming round and humped, and, the hind toe lobulated. With the exception of the Canvasback, of which I have noted two specimens, and the Ringneck (F. collaris), the only specimens of which I have noted were kept alive by Mr. Downs, and I think were originally young taken in the eastern part of the Province, the other members of this group may be called common. The scaups, bluebills or blackheads, as they are variously called, come into the Bay of Fundy about the last of October and leave us in April. The specimens noted by me were all marilla, but a mounted specimen in Halifax Museum of affinis shows both forms to be present with us. The next group, which Dr. Baird has justly united in his new genus, Bucephala, the goldeneye and buffleheads, are common, coming to the Bay of Fundy in October and leaving us in April. Though not so numerous as the common goldeneye, yet in some seasons the Iceland species may be said to be plenty, in others rare. After a careful study of many specimens of each, both males and females and immature birds, I have been enabled to generalise that both males have the violet wash in the green of the head, though Richardson makes it typical in the Iceland species; that both females have the snuff-yellow wash upon their heads, which my friend Mr. Boardman makes typical in the female Iceland: that there is a tendency in both females for the brown to run to dingy duck green on their heads, and that the party coloured bills in both females are very few in comparison with leaden coloured ones; that it appears in some young males, and their fewness can only be accounted for by considering them transient and becoming effaced by adult age. The anatomical difference in the trachea of the males (paper read March 12, 1878), must prove them distinct species. Before we notice the next group of purely pelagic duck, which never seek fresh water, are still shorter and rounder in figure, legs further behind, much better divers, but scarcely walkers at all, we may note that both these groups of pure freshwater fowl, and the intermediate one of partly fresh and sea fowl, although they do no doubt perform the semi-annual migration along our coasts, yet are never seen performing it, or are a scene in the landscape. We find them feeding in our inland lakes or dallying about our salt-tide marshes, and we scarcely know if they are successive flights or the same flocks. We have only what may be called stragglers from the eastern wing of the great migration, which doubtless makes the great freshwater streams and lakes their turnpikes further inland, and our rarer species must be the involuntary stragglers that are pressed towards the sea coast by westerly gales. The third group of migratory sea fowl are purely pelagic and procure their living by diving. They never affect the fresh waters or are seen inland. They include the heralds, the scoters, the eiders the rather scarce harlequin, and the almost extinct Labrador pied duck. Of this last species Mr. Downs secured about thirty years ago the three or four last specimens known in the Province. One of them is in the collection of Col. Drummond in Scotland; Mr. Boardman has one, and the third must be the specimen obtained by Mr. Brewster, of Cambridge, Mass., lately, and marked from Nova Scotia. Wilson, in 1818, speaks of examining many specimens in the market of Philadelphia, and in 1830 it was well known by the gunners of Newport, R. I., who called it the skunk duck, from its black and white colors. It is probable this species is becoming extinct, as the causes of its scarcity appear now permanent. Of the king duck (S. spectabilis), I have only noted three specimens, in market, Halifax, Dec. 11, 1871, one of which is now in the collection of Mr. Boardman, St. Stephen's, and though a male in full nuptual plumage, has the peculiarity of having no frontal plates to the bill. This species is so eminently pelagic in our latitudes as never to seek our shores unless driven in by gales of wind. The common eider or sea duck as it is here called, is plenty, especially in the form of the female and immature birds. I note that Mr. Egan informed me he once watched a pair nesting near Halifax, N. S., but this is the only instance that has come beneath my notice. With the exception of the harlequin, which are rare, the old wives, the three species of scoters, and the common eider ducks, make up our true migratory sea fowl.

I note a surf scoter (O. perspiliata), a young male, as early as August 8, 1879, shot at Digby, evidently a young bird of the year's; a very early date. From this date to November, the surf scoter, the velvet scoter (O fusca) and yellow-billed or bottle-nosed scoter (O. americana) come flying in the Bay of Fundy in small flocks, and remain all winter. I have never noticed the black scoter (O. nigra), though given in Wilson, Nuttall and Baird. The American student must feel obliged to Dr. Coues for returning these species to one genus, and in studying their common habits, forms, and especially common colour, and protuberance at base of bills, wonder how any naturalist, either cabinet or field, could ever have divided them into two or three genera. The old wife, or old squaw, comes to us about the same dates with these, and is often seen in company, either flying or pressed to a lee shore by heavy weather, sitting upon the waters. The eiders come in rather later, but are sometimes numerous in Spring. Whilst the semi-annual Fall migration of these sea duck are scarcely noticed, except by naturalists and gunners, whilst in the pursuit of food or warmer, seas, they seem leisurely to fill our shores and pass our rocky promontories, whilst some remain all winter, seemingly, as we are unable to say they may not be successive flocks in passing, the returning Spring seems to awake new thoughts and new feelings in all these migratory fowl. Sometimes in February, oftener during March, the garrots cease their pepetual diving; the males, with tumid heads and throats, and more brilliant and purple green reflections, swim in restless circles around the sombre female which, half buried in water, with extended neck and flattened body, evade his approach. The glass-like water is thrown into mimic surf by their play. Or the male throws his purple head far backwards till it rests upon his back, and a short shrill cry comes across the water from his upturned bill. The old wives, a little seaward, are playing the same antics, and a prolonged note, much like a distant bell-buoy, directs you to the male, with creamy and pouty head, long snowy axilleries falling athwart a velvet black back, and long tail carried straight and high, is circling around his greyish mates. The coloured gentry in these magic reels, the scoters, with lake or orange bill, and scarlet leg gleaming from the velvet darkness of their suits, play this game so stoutly that among the hardy fishermen they have gained the name of courting coots. Thus it appears that pairing takes place long before the instinct of migration moves the whole mass northwards. This migration is strongest during April, and lasts into the middle of May. Beginning far away southward and west, Florida perchance, it strikes our westernmost point, Westport, Brier Island, passes along Yarmouth, Shelburne, Lunenburg, strikes Sambro, the western head of Halifax Harbour, and pours its tide all along the eastern passages, Canseau, and finally leaves our shores at the north-eastern cape of Cape Breton. For all day long and for many days in fine weather, flock after flock of heralds, scoters, and eider ducks, every few minutes come scattering along, flying low upon the ocean, but rising when passing a rocky point. From many a rocky ledge, or boat anchored to a buoy, comes flash after flash, followed by the roar of a duck gun, and three or four victims falling headlong into the sea. The heralds and eiders seem to perform their flight first, followed by the yellow billed scoters and the velvet ducks, called May whitewing, because they prolonged their migration until May. Thus, as I have said before, these flights are obvious and make a pretty scene in the landscape, whilst the geese, flying high in the air, escape our notice, and the true ducks and their allies disappear as it were unnoticed, but no doubt performing the like migrations on inland routes and fresh water streams. Some fifty years ago, it was my delight as a boy to watch this feathery stream as it flowed by the headlands of Newport, R. I. A respectable and grave set of men called gunners locally, but termed fowlers in law, and having common rights under the "Fowlers and Fishers' Act," pursued this sport with great ardour. They had unwritten but severely respected law, of every boat's exact position on the water, and every man's right of fire on land. They owned a weather-stained old grey granite hut called the fish house, with its boats chained all round it, and further away towards the sea, a stone duck fort, a circular wall of dry stone, titanic, and looking so like what I have in after years seen the

Micmacs dwelling in, on the rough shore of the Bay of Fundy. They shot from long ducking guns, with buccaneer stocks, (the front of stock very convex,) flint locks, and every man measuring his charge in his palm, from a long curved powder horn; and yet they were good shots; and on the evening of a soft April day the fog clinging around Brenton's reef, it was a pleasant sight to see them slowly following homeward, with their big spaniels and lusty Newfoundlands, two or three horse loads full of game, each horse piled high with a feathery pyramid of black and grey, gleaming with scarlet bits of leg or bill. It was rare then to see four wheeled wagons; a manlier generation used horseback, sometimes the old two wheeled chaise. These men knew the Labrador duck, now nearly extinct, and taught me to identify the Huron scoter, for which I vainly sought in Buonaparte's catalogue, N. Y. Lyceum, and which in after years was first scientifically described by Herbert in American wild sports, allowed by Baird, but denied by Coues. Whether this sport is still carried on by breech-loaders and patent shell, I know not, but must return to our own part of the stream, and the modification time and civilization has wrought in it, not referring again to the ancient voyagers. The opinion of those most interested in it steadily maintain its rapid decrease, or at all events its alteration of route. Wilson speaks of birds now almost extinct as found in the markets. M. Audobon, speaking of the sea ducks in the Bay of Fundy, says " that by the 10th August they (eiders and scoters) are so naked of feathers and destitute of quills as to be unable to fly, and are clubbed by the Indians, sometimes to the number of two hundred and fifty in one foray, being unpaired birds remaining from the previous winter." With a fair knowledge of the southern coasts of the Bay of Fundy, and of the Indians about them, I can say these are the stories of former days, and that no such hunts are made now. Even in Labrador their numbers are declining. In the official reports of the Dominion of Canada for 1879, it is stated that the Mingan Indians, during the summer of that year, were reduced to comparative starvation from the absence of feathered game on the sea coasts. We may take the fate of a kindred species, the great auk, now universally admitted to be extinct, as a forewarning of the fate of others. If we admit, as indeed every one must, that Joseph Josselyn Gent. when writing of "N. England's varieties," 1872, was describing under the name of wobble, the great auk, then used as food and common in New England in June, "an ill-shaped bird having no long feathers on their pinions, which is the reason they cannot fly, not much unlike the penguin," the complete extinction of this bird shows what the presence of man can do. A bird organized for existence in temperate zones is pushed backwards to arctic lands, and those unable to adapt their organization to its new habitat perish. It is singular that the species now supposed to be becoming extinct, the Labrador pied duck, differs from all its co-genera in having a membranous bill and is allied (Coues) to a soft-billed species in New Zealand in this respect. May we not look to this feature among the causes of its inability to maintain that position which other species around it seem able to do. There is a growing tendency in the guillimots, the puffins and razor-bills, to become scarce about the shores of the Province, and they are less easily obtained by collectors than formerly. The family of gulls and terns, with the sheldrakes, both mergansers and goosanders, including the hooded breed here; all the species of sheldrakes, and many of the gulls, and none of them diminishing. Yet in early autumn the numbers of gulls which arrive show that we owe their presence to migration. I had scarcely noted, Tusket, Bay of Fundy, Sept., 1879, a laughing gull (L. atricilla) for the first time, before a letter reached me from my friend Mr. Broadman, St. Stephen's, saying it appeared on the St. Croix with other southern species about the same time. Of very rare species that have reached us may be mentioned the tropic bird, the frigate pelican and the purple gallinule, from the south, and the pomerine jagger from the north, and all after very heavy storms; the jagger after the one predicted by Saxby, Oct., 1869, and the gallinule Feb., 1870, a few days after the hurricane in which it was supposed the "City of Boston" was lost, and which the transport "Orontes" barely survived.

I have thus in this paper made a study of that portion of these semi-migrations that touched the shores of Nova Scotia, endeavored to show the different families of sea and fresh water fowl which compose it, their various routes, and the causes that produce this variety. Some passing over the land, aerial, scarcely noticed save by the fowler or naturalist, others taking the inland water courses, and those which visit us being almost involuntary stragglers from this great western flow. Others again making the sea their pathway, and whose numbers make them common in our market and observed by all. I have only stated what came personally to my notice or from a few friends, thinking that the narrowness of the range might be made up by the more exactness of the matter, and that perhaps others on other parts of the route may, or perhaps are now doing the same, and thus a complete account of the entire migration from personal facts be obtained. Whoever studies it is now aware he is studying a feathery stream that no longer overflows its banks, but is ever growing narrower and narrower, species dropping out, individuals diminishing, its route altering, perhaps lengthening. It is beyond doubt that that amazing feathery stream that darkened the air, blackened the coasts it alighted upon, that had streamed on for ages, indifferent to the arrows of the thinly scattered red man, made its breeding quarters far to the southward of their present home. It is certain the snow and the Canadian goose once visited Nova Scotia, and the extinct auk spent his June in Connecticut. These, perhaps, are the most arctic species now, and we have a right to infer that the less arctic ones followed their habits. The very presence of man, with his boats and ships, has done much towards this; but the alteration of their food from the ocean, caused also by his presence, his works, his wharves and docks, his pollutions, have driven away their food fish, and made them seek it in northern climes.

By whatever means, however, this feathery stream has been diminished, altered or shortened, it leaves us some speculations of the past and for the future. Are those arctic forms now breeding at Hudson's Bay the same as once bred in sunny Connecticut; have they changed in three hundred years, or are we wrong in asserting that an especial form is necessary for every zone, and that one form would not be sufficient for both places; or may it not have been that the great auk, with a form according to every naturalist of the purest arctic, flourished better in these warm seas, with this form, and owes his extinction to being pushed to where it was not adapted for existence.

On a Cub Found in a Bear's Den, Jan. 12, 1880.—By Dr. J. Bernard Gilpin.

On the 12th January, 1880, Stephen Bradford, an Indian, hunting moose in the county of Digby, Nova Scotia, discovered a bear's den,—seeing the dark skin of the bear beneath the roots of an overturned tree, covered by its mantle of snow. His gun being foul, he exploded many caps, and succeeded in arousing the bear from her hibernation. Before he could discharge the gun, she left her den, and he then tracked her through the forest in the snow for a mile and a half when she denned again. He returned to camp, cleaned his gun and returning shot her, for she proved a she bear, in her temporary den, Missing his coat, he returned to the first den, where he recollected throwing it off, and their found a cub, dead and frozen. This cub he took to my son, who was in camp at the time, and who sent it to me. Its weight was eleven ounces. It measured, when stretched out, from tip of nose to end of hind toe, between ten and eleven inches. It was covered by very fine close hair, black upon the back and head but bluish slate towards the belly and inside of limbs. The ears were naked; the eyes closed; the tongue exposed, and the jaws slightly open. There were no teeth, but the claws were much developed, and the tail long. From the umbilicus being entirely healed, and no cicatrix upon it, I judged it to be about ten days old. After a careful and measured life-sized sketch, it was placed in alcohol. Though we gain nothing new by the possession of this most rare specimen, yet we verify personal observation, and, by date, statements which have come down to us since the days of Pallas, and repeated by Richardson, Godman, and Audubon. Allowing the cub to have been ten or twelve days old when taken, from reasons I have before stated, it puts its birth about the first of January. Our snows rarely fall to any depth before the middle of November, and our bears usually seek their dens about that period for hibernation. The male bear is easily satisfied; behind the root of an upturned tree, a mass of tangled wood, or a hollow cliff in a rock serves him, and the snows soon cover him in his rugged sleep. Not so the female, parturient. She selects the most obscure and hidden places, lining them oftentimes with layers of spruce fir branches. It is an unquestioned maxim with Indians, that no one has ever taken a she bear with young. This is both owing to the obscurity of her hiding place, and the asserted fact that if disturbed she will always abort. My son, in hunting some years ago, came upon many spruce firs with their lower branches torn off and strewed about the snow. His Indian told him it was the work of a she bear lining her den. Hard by they found a crevice in a ridge of rock, which, after ascertaining it had no occupant, he entered, crawling upon hands and feet, with his Indian holding his leg. The interior was a comfortable apartment in which he could sit upright, floored by spruce boughs, and which no tired hunter would refuse as a resting place. But it is not usual to find so comfortable quarters as these. Richardson quoting from Pennant, and Godwin, both attest to the truth of our Indians' assertions regarding the deep privacy of the female in denning, The former saying, in very severe winters many bears migrate south, but no females found amongst them; and the latter asserting that out of many hundreds of males only two females were found, and those not with young. The hard and early winter had prevented the males from obtaining that condition of fat necessary for hibernation and therefore they became what our Indians call wandering bears, never denning. Instinct compelling the female to do so, as well as her always being in the proper condition, when the male is wasted by the September rut. A party with whom I was hunting in 1841, met and killed one of these wandering bears on the first of March. Our Indians also corroborate the assertions of the older naturalists, that though the bear comes out of winter quarters very fat, it all wastes in a few days. As to the degree of hibernation attained to, Stephen Bradford's narrative is verified by other Indians, and by observation of tame bears. In captivity, especially if well fed and housed, some never hibernate, but sleep much more during the winter. Others you may force into hibernation by want of food, and confining them in a dark cellar. They have been noticed in coming out of their houses into an atmosphere nearly at zero, to be covered by a thick mist of condensed invisible sweat; this is the vapour hanging over their dens in the forest, and conducting the Indian to them. They are never entirely unconscious; being poked by a stick they will growl but relapse immediately again, and it requires much poking to arouse them, as Stephen Bradford's bad powder and dirty gun did in his narrative. Having thus, as one may say, re-verified by personal observation and modern research, what are the recorded facts of the older naturalists as well as the traditions of our Indians, who have never read a book or heard of a naturalist, we may pass to those considerations which the finding of this most rare specimen has drawn our attention to, as regards its condition both within the womb and its nutrition after birth.

That so highly organized an animal as a bear should be able to retain not only his vitality but his animal heat, and his muscular strength for the space of four months, without any food whatever, is sufficiently wonderful, knowing as we do, that in this time, if there be no supply there is no waste, save prehaps of animal heat. But when we consider the female, we find there is no waste and no supply. The material for a second life, and its growth, must be taken from an accumulated fund. Taking the middle of September as the time of conception of the individual before us, and allowing she went into winter quarters about the middle of November, she then carried within her a fœtus of two months old. This fœtus she sustained, and eliminated substance for its growth for six weeks, with no exterior resources, and in a profound torpor. This torpor spreads over all organs of the body, save those of the womb. About the 1st of January, as most certainly is proved by the conditions of the cub, it must have been born. An atmosphere, saved only by the animal heat of the mother from that without the den, often approaching zero, and a torpid mother awaits this blind-born, feeble offspring. As no personal observation can ever assist us, we may only conjecture that some instinct leads it to the mamma where, like certain marsupials, it retains a firm hold upon the nipple; and now a change comes over the still torpid parent,—the blood that thus far carried nutrition to the fœtus must, as it were, change its base,—the circulation of the uterus shrinks and becomes obliterated, whilst that of the mamma must correspondently increase and allow the lacteal glands to secrete milk. And all this performed with no assistance without, but from sources accumulated nearly two months ago. To suppose the parent is roused during parturition scarcely accords with the analogy to the facts which we do know, that is, her torpor during lactition. Besides, modern science has caused, by the use of anæsthetics, the whole phenomena of birth to be performed without the knowledge of the parent; and, moreover, the care during lactition, which we know is performed during torpor, is more wonderful. The most wonderful fact is, that no food is taken by the parent during both operations. Dating the birth at the first of January, three and a half long dark months must this torpid mother secrete milk before she emerge into light or procure food for herself. The appearance of the cub at ten days old, its leanness its weight (eleven ounces), the parent sometimes weighing five hundred pounds, attests that the amount of uterine nourishment it had then received was of the smallest quantity. It was scarcely the size of a pup, one say of six or seven the litter of a bitch weighing thirty or forty pounds. That after birth it receives but little food, and passes the most of its life in semi-torpor, and scarcely grows until the parent emerges, we can only prove by their extreme smallness when found in early Spring, Unfortunately I have no dates to those I have seen at that age, or to a pair of young Polar bears I once saw, in whose instance the retreat must have been doubled in length and severity by the Arctic latitude and ice-formed den. We may here remark, that in our bear hibernation destroyed all maternal instinct;

she fled from her cub; it seems probable no maternal duties had bound it to her. Had Stephen Bradford, with his dirty gun, met her in May, he would have been only too happy to have escaped with his life instead of going to camp with her skin.

In its production of young so comparatively small, and in its privacy during parturition, our bear has an affinity to the opossum, our sole North American marsupial, but without the pouch ; and from these facts, as well as its hibernation, and its capacity of sustaining life either as a vegetarian or a carnivora, may justly be considered in its Polar or fishing variety one of the first mammals that occupied this continent on rising from its glacial submergence. The Polar variety, but few shades above the walrus, might easily have sustained life for the few short summer months on fish and seals, ere yet the emergence of rock peaks, or swampy terraces ; and when a tardy vegetation was clothing these plateaux, and before the herbiferous races appeared, his descendants straying landward thrived upon this vegetable diet, till these races appearing after their natural food had grown for them, allowed him again to become a carnivora. In this struggle of fish, vegetable and flesh life, his prolonged torpidity, perhaps at first much more prolonged in arctic regions, and destined as he advanced to warmer climates to cease, must have been of wonderful use in his struggle for existence.—*Communicated by the Author, Jan. 26, 1880.*

Art. V.—Notes on the Anatomy of a Seal from Magdalen Islands.—By J. Sommers, M. D.

(*Read Feb.* 9, 1880.)

In bringing to your notice the following points on the anatomy of a seal, I take occasion to express my sincere thanks to the gentleman through whose kindness I have become indebted for the opportunity to conduct an interesting investigation.

The seal was sent from Magdalen Islands by J. B. F. Painchaud, Esq., to Robert Morrow, Esq., who conjointly with myself made the dissection. I wish also in this place, and feel that I carry the members of the Institute with me to express the feeling of regard that I entertain for the spirit which actuated our friend Mr. Painchaud, in that he had voluntarily undertaken trouble to aid us in the promotion of the objects for which our Institute has been established. Could we infuse the same spirit into the minds of many friends less remote from us whose opportunities are probably not less than his, onr Transactions would, before long, supply to investigators all material knowledge required for acquaintance with the extent of our natural productions.

It is right also that I should make explanation here of what the subjoined notes will render apparent, viz: that our study of the Seal was far less minute and less perfect than it might have been. When it arrived in July, decomposition had set in, the heat of the weather at that time increased the process, which went on with great rapidity, notwithstanding it had been carefully injected by Mr. Skelly, the Janitor of the Medical College, who was careful also to keep it surrounded with disinfectants, yet the changes were not checked to any extent. The above circumstances necessitated a speedy dissection, and although the vessels were well filled with injected matter, and under other conditions could have been easily followed out, we were compelled to confine our work to the study of our subject, more from a zoological than from an anatomical stand point.

The following are the notes taken July the 2nd, 1879, and subsequently on days when the dissection was carried on—the subject, a young specimen of Phoca Grœnlandica, supposed age, third or fourth months, length from muzzle to tip of tail three feet, weight eighty pounds, the cuticle having peeled in many places a description of the pelage was not admissible, colour of hair was a dirty yellowish white, the skin viewed as a whole presenting, where the cuticle remained, the dark markings or spots commonly observed on seal skins from Newfoundland and Labrador, the anterior and posterior extremities had each five digits, the nails on the anterior fingers were strongly developed, those on the posterior not so large.

The animal had been caught in a net and despatched by a blow on the skull, which had fractured the bones; general shape of head broad oval, length from muzzle to occiput, ten inches, eyes fine dark prominent, with a strong nictitating membrane, which in the dead animal could be made to cover two-thirds of the globe, nostrils closed by valves or folds of mucous membrane, external ear without appendages, the meatus opening by an oval aperture upon the skin of the head in the position usual in mammalia, the meatus was beset with soft bristles, depth of canal of external ear, i. e. from meatus to typanum one and one half inches, the body on the removal of the integument presented a well nourished appearance, the sternum was prolonged upwards to the top of the larynx by a cartilaginous extension, this measured three and one half inches above the clavicles, and gave origin in its whole length to portions of both pectoral muscles, these muscles arose as in the human subject from the sternum and ribs in front, but the great pectoral was continued downward to the point of the ziphoid cartilage, their insertions the same as in man, viz: to the clavicle humerus and scapula, the positions of other thoracic muscles are so similar to the corresponding parts in human anatomy I deem it to be unnecessary to proceed with their description.

The development of these muscles in the seal corresponds more to the same in birds than in land mammals, the shoulder muscles are also correspondingly developed, the trapezius very thick, deltoid and biceps, short, thick, and strongly attached to the bones, these points in the myology of the seal can be seen only on dissection, they are covered by the general integument nearly down to the wrist joint, as however the integument is loose the bones short and articulated at opposing angles, there is much freedom of movement in the anterior limbs.

The modification of the bones at the extremities, furnishes a most striking peculiarity in the anatomy of the seal; in the superior, the scapula is broad, rounded at the edge, bearing some resemblance to the same bone in man, the fossæ for the supra and infra spinati muscles are deep, the under surface of the bones are deeply concave for the lodgment of the large sub-scapulars, the humerus very short and thick, the ulna and radius also short, but the olecranon process of the ulna is much prolonged to afford attachment for the powerful extensors of the arm, the metacarpal an phalangeal bones are developed out of proportion to the bones of the forearm, taken together they have a much greater length, the flexors and extensors of the wrist, &c., are short and thick, the tendons are long and well developed.

The inferior extremities of the seal are also confined in the general integument, the bones being shortened and otherwise modified as in the anterior extremities, yet every bone is present as in man, the gluteal muscles are short and well developed, but it is evident from dissection that the other muscles of the hind limbs in the seal are not so well developed as the corresponding organs in the anterior members, the articulation of the femoral bones, and the insertion of their muscles are such that the inferior extremities are twisted so that the tibial bones are external to the fibulæ, owing to this the palmar surfaces of the feet become opposed to each other in a position similar to that which can be produced in the hands of man by the partial rotation of the radius upon the ulna.

The phalangeal bones of the feet are longer than those of the forelimb, the claws are not so large, the tegumentary covering broader and looser, allowing great freedom of movement in these parts which are readily observed to be specially adapted for progression in the water, while comparatively useless for the same purpose on land. The tibiæ and fibulæ were free.

Opening the thorax, the viscera were examined; larynx and trachea same as in other animals, the rings of the latter being however, complete; right lung, upper lobe distinct; middle and lower imperfectly divided or marked off from each other; left lung distinctly two-lobed; weight of lungs and heart, 1½ lbs.; heart large, notched at the apex, denoting imperfectly the septum between the ventricles, four-chambered; the foramen ovale open, Eustachian valve not more marked than in the heart of adult human subjects; ductus arteriosus not present. The aorta gave off separate subclavian and carotid arteries for either side. The anatomy of the vascular system in other respects differs not from that of man.

Of the abdominal viscera, the stomach was large, having the bagpipe shape of the organ in carnivora, being also simple; it measured when distended about 14 inches in length, by about 5½ in width. There is a permanent constriction at the junction of the middle with the pyloric third due to the muscular fibres dividing the organ into two imperfect cavities. The intestines measured in length 42 feet, 3 inches; diameter, about ¾ of an inch. Mucous membrane of both stomach and intestines, desquamating was not examined microscopically. There were no valvulæ in the intestines. The stomach, &c., contained shrimps, partly digested herrings and bones. The liver had so far decomposed, its dissection or examination was rendered impracticable, no gall bladder was observed, although some attention was given to its discovery. The spleen and pancreas were not noticed; the kidneys were moderate in size; the urinary bladder small, oval-shaped; ureters much larger, "thrice," than in man; uretha measured from neck of bladder to tip of penis about thirty inches. The animal was a young male; the generative organs small. The penis was contained in a sheath or pouch of the integument of the abdomen, this sheath extends from the vent upwards towards the umbillicus, enclosing the organ so completely that a superficial glance would lead to the supposition of its being entirely absent. The penis is provided with a long bone, situated or in connection with the corpora cavernosa; the diameter in this young animal being about that of an ordinary lead pencil. The testicles are within the abdominal cavity. The spermatic cords and vessels on either side pass through a very long abdominal canal, with internal and external rings, as in man. They pass up the abdominal wall to join the root of the penis. The testicles contained no spermatozoa. The penis could be made to protrude from its abdominal sheath.

Any remarks which I am inclined to make in reference to the seal will refer only to the organs of progression, and taking the evidence afforded by their anatomical structure, it is easy to draw the following conclusion, viz.: so far as the two pairs are concerned, their uses are entirely different. The shortness and restricted movements of the anterior extremities renders them bnt of little moment in swimming. The great osseous and muscular development of these organs, along with the strength of the claws, renders them adaptable for climbing. The seal raises its own weight out of the water by means of its fore limbs; it uses them also, when on land, as a means of progression. While moving in the water they are at rest, held tightly against the body; upon the ice or solid surface the palmar surfaces of the anterior flippers are underneath. The tips of the fingers approach from side to side, and the olecranon processes point outward. The posterior limbs under like conditions are not brought into use, they trail out behind, their edges resting upon the support. They may be said to be practically useless as organs of locomotion on land, but their shape and structure eminently fits them for swimming. They present broad, flattened surfaces to the water, the regular contraction of the extensor muscles of the leg and foot causes the latter to flatten and spread; by contraction and relaxation of the hip and thigh muscles the thighs are drawn towards the abdomen and then suddenly projected from it; the broad feet striking the water, drives the animal's body forward by a succession of jumps. The seal moving in the water does not swim smoothly like a fish; on the contrary, the propulsion is due to successive arching and straightening movements of the lower portion of the body resembling very much the movements of a shrimp propelling itself by its tail. We must not forget that the hind limbs of the seal are somewhat in the condition of those of a human being, whose legs being enclosed in a bag, with his feet free, the only movement he could accomplish would be that of leaping, by drawing his thighs towards the abdomen, throwing his body, forward from the soles of his feet. The hummocky motion of the seal on land described by many, is due to their being used in such a way as described above; but as the soles of their feet cannot be brought upon the ground or ice, the animal rests upon his knees or heels, and attempts to use them as the moving point. The natural condition of the organ renders them facile in treading water, but makes them awkward and inefficient for like purposes on land or ice.

Of the whole family, the sea lions are the only ones that can rest with the palmar surfaces of their extremities upon the land, because there is greater freedom of leg and arm than in our seals. They move more freely and with greater rapidity when on land, nevertheless their movements are on the whole very similar to those of our own species.

NOTE.—The tentorium cerebellum partly of bone as in cat, falx cerebri at its junction with tentorium also formed of bone.

ART. VI.—TUBES IN THE FEET OF THE MOOSE.—BY R. MORROW.

Read May 10th, 1880.

In April, 1877, I read to you some "Notes on the Caribou," (see vol. 4, *Transactions N. S. I. N. S.*, page 281, *et seq.*,) in which I drew your attention to the tubes in the feet of the moose. I shot last December an old cow moose, in the hind feet of which the tubes were fully developed, but differed from those in the hind feet of the bull described by me (see page 292, *ibid*,) in being more perfect in shape, closely resembling the tubes in the hind feet of the old doe caribou, that is, being much narrower and more perfectly defined in their mouths, and of nearly equal diameter to their inferior extremities, also being very strongly marked, as in the caribou, by the coarse, bristly tufts of hair which issue from their mouths. The inferior extremities of the tubes are attached, as in the caribou, by strong fascia to the superior surface of the skin of the web, or soles of the feet.

In the fore feet the tubes were nearly obliterated, existing only as a slight depression in the skin, about one inch in length, the tube proper being so reduced as scarcely to be perceptible; this depression, lying between the phalanges, is attached as in the hind feet, by fascia to the sole, but the fascia extends to the middle of the depression, marking what was originally the lower extremity of the tubes, and it is therefore of greater length than that in the hind feet. There were no bristly tufts marking the tubes in the fore feet of this cow moose, as are in the fore feet of the doe caribou.

ART. VII.—NOTES ON THE BONES OF SALMO SALAR SPECIMEN FROM LABRADOR. BY R. MORROW.

Read April 19th and May 10th, 1880.

Spinous Rays, &c. BEGINNING at the junction of the dorsal ridge with the occiput there is a bony process in advance of the first spinous ray; flattened vertically, somewhat broader above, but stouter below, it is attached to the dorsal region by stout fibrous tissue, its ventral extremity at about midway to the 1st spinous ray, and it is the first interspinous bone;* it is entirely different in form, from its representative in the ubiquitous perch, and were it cut out and looked at merely as a fish bone, few would recognize it as an interspinous bone, from the description of such bones as usually given.

2 & 3. The 2nd & 3rd spinous rays have each a short interspinous bone attached to their extremities, overlapping posteriorly.

4. This ray is without the intersp. bone.†

5. The 5th spinous ray has its interspinous bone overlapping in front, and rather longer than those belonging to 2 & 3.

6—15. All these sp. rays have their intersp. bones overlapping anteriorly, but the 15th spinous ray curves posteriorly rather more than Nos. 12, 13 & 14, and at the 15th sp. ray there is an extra interspinous bone $\frac{2}{14}$ (making 2 bones $\frac{1}{14}$ $\frac{2}{14}$) which does not reach, but its end is opposite the front of the 15th spinous ray, distant about one quarter of an inch from it; it does not rise so high in the dorsal region as the other interspinous bones, say $\frac{1}{4}$ of an inch less than $\frac{1}{14}$ ($\frac{2}{14}$ lies immediately behind $\frac{1}{14}$, from which it is distant about $\frac{1}{8}$ an inch); $\frac{1}{14}$ and the preceding intersp. bones are nearly equidistant from each other; $\frac{2}{14}$ is very nearly a straight bone, tapering slightly from its dorsal to its ventral extremity. The dorsal ends of the 14 interspinous bones have somewhat broad heads‡ for the attachment of the muscular tissue, and all are curved anteriorly,

16. This spinous ray is without an intersp. bone, but the 4th intersp. fin bone of the dorsal is slightly in front of it.

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* In younger specimens this 1st intersp. bone has almost always its ventral extremity lying between the superior extremities of the 1st spinous ray; as this ray becomes more solid, the intersp bone seems to be pushed out.

† In a fish from Cape Breton the 4th has an interspinous bone, but the 5th is without.

‡ More perceptible in smaller specimens.

16 & 17. Between the points of these spinous rays* is the 5th intersp. fin bone, and at the 17th begins the shortening or hollow in the sp. rays for the insertion of the dorsal fin.

17 & 18. Between 17 and 18 is the 6th intersp. fin bone.

19. Opposite the point of 19, perhaps slightly in front, is the 7th intersp. fin bone.

19 & 20. Between 19 and 20 is the 8th intersp. fin bone.

21. Nearly opposite the point of 21, slightly in advance of it, is the 9th intersp. fin bone.

22. Nearly opposite the point of 22, perhaps a little anterior, is the 10th intersp. fin bone.

22 & 23. Between these, slightly in front of 23, is the 11th.

23 & 24. Between these, slightly in front of 24, is the 12th.

24. Opposite 24 is the 13th intersp. fin bone.

24 & 25. Between these, slightly in front of 25, is the 14th.

26.† Slightly in front of 26 is the 15th intersp. fin bone; at the posterior junction of these intersp. fin bones with the fin rays, and attached to the prolongation of the 15th intersp. fin bone from its lower extremity, the fibrous tissue descending and attached to *26, 27, 28, 29, 30*—the 26th, 27th, 28th, 29th and 30th spinous rays, is rather stronger than that which is attached to the other sp. rays. The height of the intersp. column from the centre of the vertebræ, at right angles to the junction of the fin rays, is at the anterior face of the dorsal fin $3\frac{1}{2}$ inches; at the posterior face, $3\frac{1}{4}$ inches; length of dorsal from anterior to posterior edge is $3\frac{3}{4}$ inches, and, including the prolongation of the 15th intersp. fin bone, $4\frac{1}{4}$ inches.

29-42. From, and including 29 to 42, the superior caudal spinous rays are wider at their dorsal ends than are the other dorsal sp. rays; from 26 to 42, the height of the dorsal sp. rays is nearly

42-53. equal, and from 42 to 53 they rapidly decrease in length, and their dorsal ends are comparatively narrow.

54-55. At the point of this sp. ray begins the upper or dorsal portion of the caudal fin (the ventral portion begins also at the 54th). The 54th and 55th sp. rays are anchyclosed at their

*The shortening of the spinous rays for the insertion of the dorsal I do not find in some specimens of the Cape Breton Salmon.

†The hollow for the dorsal is here completed and the spinous rays begin to rise.

bases, and towards the anterior dorsal edge of 55 the bony plate nearly touches 54.

55, 56, 57. Are anchylosed, and on 57 is the last dorsal spinous ray proper; but in addition, and anchylosed with the three spinous rays above named, are two or three other rays, which may be termed representative. I cannot decide their number they are so confused. These three rays unite with a short bone, which is attached to the 57th sp. ray, and lies nearly parallel with the 57th and 58th spinous centra. The 57th spinous centrum begins to rise, that is, to curve upwards towards the dorsal edge of the caudal fin, and with the 58th and 59th centra and the lower Y shaped bone between the forks of which the notochord passes, forms an angle with the anterior part of the spinal column of about 35 degrees.

Saddle bones. Beginning at the posterior edge of the 56th centrum are a pair of bones of irregular and peculiar shape, one on each side of the spine. They are attached to the dorsal edge of the spine, and are joined by strong cartilage in this specimen, by their ventral anterior edges to the posterior edge of the 56th centrum, covering the ventral end of the 57th sp. ray, anteriorly about $\frac{1}{8}$ of an inch, nearly at the middle of its height; their dorsal edges pass over the 57th sp. ray, posteriorly they cover and attach the three rays which do not reach the spinous centra, 58 and 59. These bones, which, for lack of a better name, I will call *saddle* bones, attach the three rays which I have already spoken of as representative rays, by cartilaginous union to the spinal column. When these bones are in their proper position the spinous rays appear to be all perfect; but the 58th and 59th centra have no dorsal spinous rays. Close to the posterior end of these saddle bones, protecting the notochord, and lying under the anterior edge of the short caudal fin ray, No. 10, reaching nearly to the dorsal edge of the spinous centra, is on each side a short irregularly shaped bone, about $\frac{3}{8}$ of an inch in length, somewhat pointed at either end. On the outer sides of the posterior extremities of these two short bones, the points of the short caudal rays next to the first perfect dorsal caudal fin rays, right and left side, have a slight attachment.

The next bone we meet has its anterior edge divided, that is it is Y shaped, so as to admit between its points the passage of the notochord, together with its protecting tissues, and the posterior edges of the saddle bones nearly touch the points of this bone. Its posterior or outer edge is united, but in a younger specimen would probably be found as two separate bones. This bone is of the same shape, but about half the size of the Y shaped bone to be noticed in the ventral aspect of the spinal column.

I have thus reached the dorsal extremity of the spinal column, not including the spongy centrum to which the fourth or upper hypural bone is attached, and which makes, if included, 60 vertebræ.

Spinal Column, Ventral aspect—Ribs.

C 1 & 2. There are no ribs on the 1st and 2nd centra, these being so situate as not to require them, but there are their representatives in the shape of processes.

1st pair on 3rd. From the 3rd centrum, at its lower edge spring the first pair of ribs, which are somewhat crooked in shape, and naturally shorter than the others. They are comparatively round bones, and in length from articulation to point 2 inches.

C. 4. The second pair of ribs, measured in a direct line, that is not following their curve, are $2\frac{3}{4}$ inches in length and slightly deeper measured transversely than they are laterally, and taper to a point.

C. 5. The third pair are $3\frac{1}{4}$ inches long.

C. 6. The fourth pair are $3\frac{3}{4}$ inches long.

It is not necessary to give the lengths of the remainder of the ribs, but it may be remarked that I find in the Salmon, that the first two pair of ribs may be termed short, and that from and including the 3rd pair, to and including the 13th pair, they are of much greater transverse than longitudinal diameter, decreasing in the length of the transverse breadth as they succeed each other posteriorly—7 to 12 are the longest and broadest ribs. The remaining ribs are widest at their attachment and gradually decrease in size towards their points.

C. 27. At the 25th pair of ribs on the 27th centrum are a pair of very short spinous processes lying in front of their articulation with their centrum.

C. 28. The 26th pair of ribs have spinous processes about $\frac{1}{8}$ of an inch in length, to which they are attached and pass posteriorly to their articulation.

C. 29. The 27th pair are united by cartilage to the end of, and behind spinous processes $\frac{1}{2}$ an inch in length on the 29th centrum, their ends do not reach the centrum but are attached posteriorly to the sp. processes. This pair are not so flat as their preceding ribs.

C. 30. The 28th pair. The spinous processes to which this pair are attached are $\frac{5}{8}$ of an inch in length, and their attachment rather more than a quarter of an inch.

C. 31, The 29th pair are attached posteriorly to strong sp. processes $\frac{5}{8}$ of an inch in length, which are united transversely forming the first hæmal arch.

C. 32. The 30th pair. Their spinous processes are also about $\frac{5}{8}$ of an inch in length to which the attachment of the ribs is about $\frac{3}{8}$ of an inch.

C. 33. 31st pair of ribs } have sp. processes $\frac{3}{4}$ and $\frac{15}{16}$ of an inch
C. 34. 32nd do. } in length, and have short attachments to their processes.

C. 35. On this centrum (the last of the abdominal centra), attached to spinous processes, which are united at their ventral ends, are the 33rd and last pair of ribs. A hasty examination of this specimen might lead me to say that it has only 32 pairs of ribs ; but the dorsal ends of the 33rd pair are attached closely together and to the narrow point of their sp. processes, and are anchylosed. The examination of younger fish makes this certain. This pair of united ribs forms the support of the anterior interspinous fin bone of the anal fin, which in this case it overlapped, and was attached on the right hand side about $\frac{3}{8}$ of an inch.*

The ventral ends of the last five or six pairs of ribs gradually approach each other until they touch in the last or 33rd pair,

* The sp. processes on the 29th, to and including the 33rd and last pair of ribs, are transversely united, making five abdominal hæmal arches.

producing the beautiful outline of the posterior part of the salmon.

C. 36. On this centrum (the first of the caudal centra proper), the spinous processes are $1\frac{1}{8}$ inches in length, and attached posteriorly for $\frac{3}{16}$ of an inch is a bone or bones having an extreme divergence from the normal angle, which might be taken for a pair of ribs. The sp. processes, of which mention has been made, are all of the same character as the dorsal and other spinous rays, that is formed of two bones, one springing from each side of the arch and united moie or less strongly, as the age of the fish may be. This bone, or if you choose pair of bones, are anchylosed and appear as one, their length from the junction with the sp. processes is $2\frac{3}{16}$ of an inch ; in the skeleton before you the separation of their ventral ends is a consequence of their dryness. An examination of young fish will show you that this bone (or bones) originates in a different way from the ribs ; looking at this skeleton of what may be called a mature fish it appears to be a single bone and to have originated and grown from the end of the spinous process, passing and uniting with its next posterior ventral spinous ray having its ventral end attached to the end of the third interspinous fin bone of the anal fin which it slightly overlaps, say $\frac{1}{4}$ inch on the outer and right hand side. In a young fish you will find the spinous processes, but the long bone is merely a short straight bone lying between the processes on the 36th and 37th centra; in the skeleton of the young fish before you the bone does not touch the posterior edge of the 36th sp. process, but is about $\frac{1}{16}$ of one inch from it, and it just touches the anterior edge of the spinous process of the 37th centrum, the end of which it does not reach by nearly half an inch; it is therefore most probable that it grows from a centre each way, that is dorsally and ventrally, but that its growth is most rapid towards its ventral extremity.

C. 37. On this centrum (counting the ribs as sp. processes) the 35th ventral sp. ray is attached, and is the first ventral sp. ray having the usual form ; it is $1\frac{1}{4}$ inches in length, its ventral anterior extremity is united by cartilage to the bone just mentioned as springing from the end of the 34 sp. process, the great divergence of which will be perhaps better understood by mentioning that while it lies at an angle of abont 14° with the spinal column, the ventral sp. ray springing from this centrum forms its angle about 65°.

C. 38. The spinous ray No. 36 is about 1$\frac{3}{4}$ inches long (being a sudden increase of length) and is free—that is, only attached by tissue to the interspinous fin bones of the anal fin. It and the succeeding four spinous rays have wide ventral ends for similar attachment, and are of about equal length.

C. 39. The end of the 37th sp. ray has opposite its point the 4th intersp. bone of the anal fin.

C. 40. The 38th sp. ray has opposite its anterior edge, the 5th intersp. anal fin bone, and opposite its point, the 6th intersp. fin bone.

C. 41. Slightly in front of the 39th sp. ray is the 7th. intersp. fin bone, and the 8th is opposite its point.

C. 42 The 40th sp. ray has opposite its centre, the 9th intersp. fin bone; and the dorsal extremity of the 10th and last intersp.

C. 43 fin bone of the anal lies exactly between this and the 41st sp. ray, which is about the same length as the five preceding rays, but its ventral end is somewhat narrower.

C. 44. The 42 sp. ray.
45. " 43 "
46. " 44 "
47. " 45 "
} The ventral extremities of these 4 spinous rays are about the same breadth as the 41st, but the tissue attaching to them, the posterior edge of the 10th intersp. fin bone of the anal, which curves posteriorly (its ventral end being opposite at right angles to the end of the 44th spinous ray, in order to afford sufficient support), is stronger than that in some other parts of the fish. The total depth of the skeleton at the anterior edge of the anal fin to the edge of the dorsal sp. rays is 5 inches, and at its posterior edge 3$\frac{1}{8}$ inches.

C. 48. The 46 sp. ray.
49. " 47 "
50. " 48 "
51. " 49 "
52. " 50 "
} These sp. rays are regular in shape, but their ventral ends are not expanded, they show a gradual decrease in length, which begins from the 41st sp. ray, the 50th ray being 1$\frac{1}{8}$ inches long.

C. 53 51. This ray is stronger than those immediately preceding it. Its breadth is about equal throughout. It has a somewhat blunt ventral end, and it is 1¼ inches long; in the slight hollow between this and the 49th sp. ray, is attached the beginning of the caudal muscle which envelopes the short rays of the caudal fin.

C. 54. Opposite the end of the 52 sp. ray begin the short ventral rays of the caudal fin at right angles to the posterior edge of the 56 centrum. The character of the attachment of the ventral sp. rays appears to change with this centrum, their dorsal ends have spread and are in one sense flattened and seem to have an articulated surface as may be noticed by looking at the 52nd, 53rd, 54th, 55th, and 56th ventral sp. rays on this skeleton. The posterior edge of this ray (52) is anchylosed with the anterior edge of 53 for about two thirds of their length from their dorsal towards their ventral extremities.

C. 55. The 53 sp. ray. } these bones are more or less perfectly
56. " 54 " } anchylosed, their shapes are so irregular
57. " 55 " } that only a drawing (which I regret to say I am unable to make) or reference to the skeleton can give you a clear understanding of them.

58—56th sp. ray. This ray is anchylosed on its anterior edge to the 55th sp. ray for about half its length, say ⅝ of an inch, and on its posterior edge rather more than half its length, say half an inch from its foramina* towards its ventral extremity, to the lower hypural bone; on its ventral end it is free, say $\frac{7}{16}$ of an inch. In shape this ray differs from all the others, at its dorsal end it is somewhat triangular, having a cup-like projection on each side at its junction with its centrum, and its ventral end is included in a cartilaginous rim which passes round the bones forming the termination of the column. This bone, together with the two saddle bones on the dorsal aspect of the spine, appear to me to be the representative of the pelvic bones in mammals.

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*The foramina in this bone are for the passage of the blood vessels. The superior in this specimen passes to the left, the inferior to the right side, each opening into a sack or sinus having a communicating foramen which lies between the first lower and second lower hypural bones. There is also a foramen at the junction of this bone with the anterior edge of the lower hypural in this specimen, of considerable size, in others smaller in proportion.

59–$\frac{1}{H}$. To this vertebral centrum is attached the lower hypural bone, which has a somewhat narrow neck, caused by a foramen on its anterior edge, which passes between it and the ray on the 58th centrum, and a double foramen passing between the posterior edge of this hypural bone and the anterior edge of the second; this double foramen appears to be for the passage of vessels uniting the (pulsating?) sacks. Also attached to this centrum is the second hypural bone; it is notched on its ventral anterior surface by the foramen above mentioned, the division of which is nearly parallel with the centrum; this division is caused by a slight projection in the centre of the foramen on this, as well as on the bone already described. At the posterior extremities the adjacent faces of the above two bones are partially rounded, that is, their adjoining corners are rounded off, and in the hollow thus formed, which is slightly above a line drawn through the centre of the spinal column, is a nervous corpuscle, so shrunken in this skeleton as now to be scarcely observed, but when fresh, it measured three-sixteenths of an inch in diameter. This corpuscle projects slightly beyond the edge of the hypural bones.

60. Attached to the ventral surface of a spongy centrum is the third hypural bone, and to its end, if indeed it does not belong to it, is attached the fourth hypural bone, terminating the sixty centra of the spinal column. We have therefore four hypural bones, which being strongly connected together as well as to the posterior ventral rays, form a broad solid plate for the attachment of the muscles, and the strengthening of the rays of the caudal fin. The bone lying next above this and completing the spinal column is the urostyle, covering as before mentioned the notochord.

Prof. Huxley's drawing, representing the tail of the *Salmo* published in his "Manual of the Anatomy of Vertebrated Animals," page 20, is incorrect if the *Salmo* of England is the same as ours. He makes the vertebral column in this drawing to end in a line common to the anterior vertebræ, and at the end of the last centrum which is drawn of greater diameter than those which precede it is attached the terminating bony plate or urostyle, and to the ventral edge of this are attached *two* hypural bones. There are also some other bones which do not correspond to some in our *salmo*. On page 131 of the same work he says "the spinal "column appearing to terminate in the centre of a wedge-shaped "hypural bone, to the free edges of which the caudal fin rays are "attached, so as to form an upper and a lower lobe, which are "equal or sub-equal. This characteristically Teleostean structure "of the tail-fin has been termed homocercal—a name which may "be retained, though it originated in a misconception of the re-"lation of this structure to the heterocercal condition."

The caudal fin-rays in my specimen are not attached to the "free edges of the hypural bones," but their divided ends overlap the hypural bones on each side; on the dorsal part about five-eighths of an inch; a quarter of an inch on the central, and from a quarter to half an inch on the inferior or ventral part. In the drawing referred to one of the fin-rays is inserted in a notch in the posterior edge of the upper hypural bone, nearly in the place where the corpuscle already mentioned should be.

Transverse Processes.

The transverse processes are attached directly to the centra, and begin on the 1st centrum. The first four are nearly at right angles to the column, and project posteriorly into the fleshy tissue, and are say $\overline{\overset{1}{1\frac{1}{4}}, \overset{2}{1\frac{1}{2}}, \overset{3}{1}, \overset{4}{1\frac{1}{8}}}$ inches in length, from 4 to 25, their outer extremities rising gradually towards the dorsal line. They are of variable length, 1 to $1\frac{1}{2}$ inches, not gradually decreasing, but some long, others shorter—including 26 to 32, they rise rapidly towards the dorsal line, so that their dorsal ends are near to the spinous rays; all the transverse processes arise from their centra posterior to their corresponding ray. Besides the transverse processes enumerated, which are bony, there are some that appear to be attached by tissue to their centra, having soft bony extremities; these have their attachment gradually rising on the dorsal spinous rays, but soon they lose their bony texture, and appear only as threads attached to the muscular tissue.

Dorsal Fin.

The dorsal spinous rays make an angle with the spinal column (speaking generally) of from 35 to 42 degrees, and the first interspinous fin bone of the dorsal fin consists of three bones anchylosed, appearing at the articulation of the dorsal fin ray as one bone expanding into three. The anterior edge of these bones has a somewhat broad face, three-sixteenths of an inch at its widest part, and it is seven-eights of an inch in length; from the dorsal end of $\frac{1}{14}$ interspinous bone, springs a very strong fibrous attachment, embracing the inserted ends of the triple intersp. fin bone; it then passes downward and is strongly attached to the end of the 4th intersp. fin bone (counting the short bones above mentioned, as three), which is the first long intersp. fin bone of the dorsal fin. This bone is slightly in front of the 16th spinous ray, which has no extra interspinous bone. The 16th sp. ray is a little less in length than 15, and from it, to and including the 25th ray, a gradual curve is formed by the extremities of the dorsal spinous rays for the insertion of the dorsal fin and its appendages.*

1st intersp. fin bone, $\frac{7}{8}$ in length.
2 " " " 1 " } these 3 bones anchylosed.
3 " " " $1\frac{3}{8}$ "

4 intersp. fin bone, is $2\frac{11}{16}$ inches in length, and forms an angle of 42 degrees with the vertebral column, while the sp. ray (16) to which it is opposite makes an angle of 35 degrees.

5 intersp. fin bone $2\frac{5}{8}$ inches lies between the points of 16 & 17 sp. rays, angle 40 degrees.

6 intersp. fin bone $2\frac{1}{2}$ between 17 & 18, angle 43 degrees.
7 " " " $2\frac{1}{8}$ slightly in front of 19, angle 54 degrees.
8 " " " 2 between 19 & 20, angle 55 degrees.
9 " " " $1\frac{7}{8}$ slightly in advance of 21, angle 55 degrees.
10 " " " $1\frac{3}{4}$ slightly in front of 22, angle 55 degrees.
11 " " " $1\frac{3}{4}$ between 22 & 23, angle 56 degrees.
12 " " " $1\frac{5}{8}$ slightly in front of 24, angle 55 degrees.
13 " " " $1\frac{5}{8}$ opposite the point of 24, angle 52 degrees.
14 " " " $1\frac{5}{8}$ slightly in front of 25, angle 51 degrees.

* This is much more apparent in the skeleton of the young Salmon.

15 and last intersp. fin bone is $1\frac{1}{2}$ inches in length. It has a prolongation posteriorly for the attachment of the last single together with the double fin ray, and also for the strong fibrous attachment which connects it with the dorsal muscle.

The fin-rays of the dorsal fin are in number 15. By some they would be counted as 14, but further on I will give the reason for counting them as 15.

1st ray. This ray is so small as to be easily overlooked in young specimens. In this one from its root or articulation with its intersp. bone it is five-sixteenths of an inch in length : the point of it reaches only through the skin, but it is a true ray, having its bony regular articulation just above the anterior face of the short one on the triple bone.

2nd ray. The second ray is five-eighths of an inch, and

3rd ray. The third ray is one and three-eighths inches in length, these first three rays are covered or, as it were, included in the integument as one ray.

4. The fourth, or first ray having its full length, is three and seven-eighths inches from articulation to point; divided at its ventral extremity to form its articulation on each side of the interspinous bones, as are all the fin-rays.

5 to 10. Are all of the same type gradually decreasing in length to ten, which measures two and three-eighths inches.

11. The eleventh ray is two and one-eighths inches.

12. The twelfth ray is one and seven-eighths inches.

13. The thirteenth ray is one and five-eighths inches.

14 & 15. Although apparently so closely united, 14 & 15 are separate fin-rays, having each an articulation, that is, the 15th ray is set within the 14th. They are attached as before stated to the posterior extremity of the 15th intersp. fin bone, and if the first three short rays are to be counted, then should these rays be counted as two, for though they are articulated to one base, yet each is a complete ray.

The height of the interspinous bones of the dorsal fin, to the junction of its fin-rays, from the centre of the vertebræ at right angles to the anterior edge of the fin, is three and a half inches; at the posterior edge, three and a quarter inches; length of dorsal fin from anterior to posterior edge, (rays only) three and three-quarters inches, and including the end of the last interspinous bone four and a quarter inches.

Adipose Fin.

Of the adipose fin there is little to say. Its anterior edge is opposite the posterior edge of the base of the anal fin. It has no attachment through the dorsal muscle to the general muscular tissue. It appears to be an expansion of the integument, and has its base in the cord of the dorsal muscle, which is somewhat thickened and of firmer structure (more like a cord), where it appears, more so anteriorly than posteriorly. There does not appear to be in it anything which can be called a fin-ray. I have examined a number of *S. salar* as well as *S. canadensis*, with a good glass without discovering any trace of what might be termed a ray, but I cannot say that the microscope would not bring them to view. The only difference observed by me is that while most are smooth and rounded off at the dorsal edge, some present a few of what might be termed raylets, forming a delicate feathered edge.

Caudal fins.

At the point of the 54th spinous ray begins the upper or dorsal portion of the muscle of the tail rays: this beginning of the caudal fin, which is enveloped by the muscle consists of eleven short rays or spines, filling in and giving to the tail as a whole its line of beauty, strengthened by the anchylosed dorsal sp. rays, and adding to the propelling power of the tail. These short rays are all divided at their anterior ends (or V shaped) united on each side to the general structure, presenting at the dorsal edges the appearance of single rays.

1-4. 1-4 are short and straight.

5-6. 5-6 are somewhat curved, the 6th more pointed at its outer extremity than the 5th.

7. 7 is single at its insertion and divided into two rays at its extremity, and from its division to outer end somewhat curved and pointed.

8 & 9. The 8th & 9th are single at their insertion as well as at their dorsal ends. 9 is one and a half inches long.

10. The 10th short ray is nearly straight. Between ten and eleven, attached to the upper edge of the 11th short fin-ray, at about $1\frac{1}{2}$ inches from its inferior end is an extra bone $\frac{9}{16}$ of an inch in length.

11. This ray is nearly straight, curving at its outer end to follow the shape of the long rays; it has a very thin pointed ventral end; its length is two and a half inches.

The first short fin-ray is about $\frac{5}{16}$ of an inch long.

The eleventh short fin-ray is about two and a half inches long.

The caudal fin has nineteen long or perfect rays (their insertion in this specimen will average about one inch in length), which begin to divide or split up into a great number of fin-rays, shortly after the exit of the tail from its root or body of the fish. The first and second rays counting from the dorsal region are exactly opposite to the centre of the elevation of the spinal column, so that there are seventeen whole rays beneath it.

1 to 8. The first eight rays are closely united by strong fatty tissue to their emergence from the integument.

8 to 9. Between the inferior ends of eight and nine there is a space of irregular outline filled with fatty tissue which extends some distance between these rays, at its widest part it measures $\frac{3}{16}$ of an inch.

9 & 10. The inferior extremities of these rays meet for $\frac{3}{8}$ of an inch and are then separated for about $\frac{5}{8}$ of an inch.*

10 & 11. Are separated at their emergent ends.

11 & 12. do. do. do.

The 9th, 10th, 11th & 12th rays are broader on their inserted ends by cartilaginous matter, than are the other rays.

12 & 13. The inserted ends of 12 and 13 join for about a quarter of an inch, but are then widely separate, and the ray thirteen is inserted into the root of the tail an eighth of an inch more than twelve.

All the spaces enumerated above, beginning between eight and nine and continuing to that between twelve and thirteen extend into the tail proper as a sort of web by which the tail may be expanded and contracted in its width.

* 10th ray.—A line drawn through the centre of the spinal column touches this ray, the centre ray of the caudal fin.

13 & 14. Are close together to the beginning of the tail proper.
14 & 15. Are close at their inserted ends, slowly separating until divided for the expanse of the tail, when they appear as close together.
15 & 16. Almost unite for one inch, they then appear as slightly separate.
16 & 17. Inserted ends close, then very slight separation.
17 & 18. Same as above.
18 & 19. Close together, nineteen being the ventral ray. The first three outer rays of both aspects of the caudal fin, dorsal and ventral are very strong.

The short rays of the caudal fin on the ventral side beginning at the end of the fifty-fourth spinous ray, are eleven in number.

1st. This short ray which is next the nineteenth caudal ray proper, is $2\frac{1}{2}$ inches long.

2nd. The second short ray is 2 inches long.

} these two are nearly straight and pointed at either end.

3rd. The third short ray is $1\frac{3}{4}$ inches long; pointed and slightly curved laterally.

4th. The fourth short ray is $1\frac{1}{16}$ inches long; more curved laterally than the third.

5th. The fifth short ray is 1 inch long; slightly curved.

6th to 11th. These are all curved more or less, and the eleventh is a quarter of an inch long. The points of these short rays are united as the spinous rays, and enveloped as the dorsal short fin-ray by the tail muscle; they have a little more separation than the dorsal short fin-rays, and are deeper than their breadth.

Anal fin.

The anal fin begins, or rather the anterior end of the first intersp. fin bone is attached, as before stated, to the end of the 33rd pair of ribs (on the 35 centrum), This intersp. bone is $2\frac{5}{8}$ inches long, and has upon its ventral anterior surface a heart-shaped shield, half an inch wide at its dorsal edge, and in depth $\frac{3}{8}$ of an inch, which is attached by cartilage to the intersp. fin bone. On the lower face of this shield or plate is a short cartilaginous ray, (half an inch long) having a bony base. It has no articulation but cartilaginous matter between it and its suspending plate. This soft ray is so closely covered with fatty tissue as scarcely to be noticed unless by dissection.

1st ray. Directly in a line with the first intersp. fin bone is the first short fin ray, which (as do all the remaining fin rays) divides at a short distance from its articulation with the intersp. fin bone, one half passing to each side of it, the foot shaped joint pointing posteriorly being comparatively shorter than the others. The length of this ray is $1\frac{1}{8}$ inches, and its anterior face is attached by tough fatty tissue to the rudimentary ray first described.

2nd. The second short fin-ray is directly opposite, and attached to the end of the second intersp. fin bone, shaped like the first. It is $1\frac{3}{4}$ inches long.

3rd. The third or first perfect fin-ray is attached to the anterior edge of the third intersp. fin bone, and this in its turn is attached to the end of the peculiar spine, which springs from the thirty-sixth centrum, and to which as before noticed the end of the thirty-fifth ventral sp. ray is united. And here it would seem that as this is the first perfect or full length fin-ray of the Anal, some provision was required to add to its strength, which is attained by the junction of the thirty-fifth spinous ray with this long slight bone. The thirty-sixth sp. ray being directly between the third and fourth intersp. bones, leaves a space rather more than one-fourth of an inch in width and thereby changes the angle of the remaining intersp. fin bones. Thus the general angle formed by the first intersp. fin bone with the spinal column, which intersp. fin bone is attached to the thirty-third pair of ribs, is thirty degrees, while that formed by the fourth intersp. bone is thirty-seven degrees.

4th. The fourth fin-ray is attached to the centre of the fourth intersp. fin bone.

5th.	Same attachment to five.	intersp. fin bones.
6th.	" " " six.	
7th.	" " " seven.	

The 3rd, 4th, 5th, 6th and 7th fin-rays are thicker than the others.

8th. The eighth fin-ray is not so strong as its anterior five rays, and is attached to the eighth intersp. fin bone. As the length of the rays of the anal decrease so does their strength, but much more in proportion in this and the remainder of the rays.

9th. The ninth fin ray is on the 9th intersp. fin bone, which is slighter in proportion than the 8th or 10th intersp. fin bones. The tenth intersp. fin bone, the end of which lies between the 41st and 42nd spinous rays, with its posterior ventral extremity opposite at right angles to the end of the 44 sp. ray is, as will be noticed by you, differently shaped from all the other intersp. fin bones of this fin (somewhat resembling the posterior intersp. fin bone of the dorsal fin) having a strong posterior curve at its ventral extremity, and an increase in breadth, presenting a broad face (or end) for the articulation of three fin rays, counting, as on the dorsal fin and for the same reason, the last rays as two. Its extreme posterior edge is furnished with the usual attachment for the muscular tissue which supports the posterior edge of the fin.

10th. The tenth fin-ray is attached to the anterior edge of the tenth intersp. fin bone, which as just noticed has a slight projection for its articulation.

11th & 12th. These two fin rays lie closely together, but as they have a double articulation (as the two on the dorsal fin), they clearly must be called two distinct rays. They are also (as in the dorsal) articulated one within the other, and attached to a slight depression closely in front of the posterior edge of the tenth interspinous fin bone.

Mem.—1 intersp. fin bone $2\frac{5}{8}$ inches long.

2	"	"	"	$2\frac{5}{8}$	"	"
3	"	"	"	$2\frac{1}{2}$	"	"
4	"	"	"	$2\frac{1}{8}$	"	"
5	"	"	"	$2\frac{1}{16}$	"	"
6	"	"	"	2	"	"
7	"	"	"	$1\frac{7}{8}$	"	"
8	"	"	"	$1\frac{3}{4}$	"	"
9	"	"	"	$1\frac{5}{8}$	"	"

10 " " " $1\frac{3}{4}$ inches long to depression for attachment of the eleventh and twelfth fin rays.

1–5. The 1st, 2nd, 3rd, 4th and 5th fin rays are slightly separated from each other.
5 & 6. Between 5 and 6 there is nearly $\frac{1}{8}$ inch of space.
6 & 7. Between 6 and 7 a little more, say $\frac{1}{8}$ inch of space.
7 & 8. Between 7 and 8 a little more than $\frac{1}{8}$ inch of space.
8 & 9. Between 8 and 9 a full $\frac{1}{4}$ of an inch of space, just below their articulation.
9 & 10. Between 9 and 10 not quite $\frac{1}{4}$ of an inch of space.
10 & 11. Between 10 and 11 just perceptibly more than between nine and ten.
11 & 12. Touch but are not united, and are therefore separate rays.

Ventral Fins.

These fins are attached to two bones which are embedded in the strong fatty muscular tissue in the belly of the fish. They appear on its surface opposite at right angles to the 12th dorsal ray, and are attached to the two bones already referred to, commonly called the pelvic bones, which in this specimen are $3\frac{1}{4}$ inches in length, measured from the centre of the left bone to its point or termination of its junction with the bone of the right side to which it is united* by cartilage, forming a somewhat rounded termination. For convenience I will take one, the left of these bones. You will notice at once its peculiar shape, its posterior end has a stout transverse ridge; extending and springing from this laterally on its outer edge is a ridge increasing a little in size until it is about $\frac{1}{8}$ of an inch in thickness, rounded on its dorsal aspect and projecting rather more than $\frac{1}{16}$ of an inch above a thin bony plate $\frac{5}{8}$ of an inch in breadth at its posterior extremity; decreasing anteriorly to a point which is united to the transverse ridge as far as its inner end, and extending along the lateral ridge two inches, this lateral ridge being prolonged anteriorly $\frac{3}{4}$ of an inch beyond the thin plate or blade. On the ventral aspect the plate or blade rises, following the curve of the lateral ridge which in consequence does not show any abrupt projection. The posterior end of the bone or transverse ridge is, in this specimen, one inch in breadth, and to it the

* In young specimens they can scarcely be said to be united.

fin-rays are attached. The outer head of the transverse ridge projects a little beyond the lateral ridge, the space so formed being filled with cartilaginous matter from which springs ligamentous attachment running some distance along and tying this bone with the muscles of the belly. On the inner edge of the bony blade and attached to the cartilage on its anterior edge, strong fibrous tissue passes enveloping the blade as well as the anterior ends of the lateral ridge, from thence passing to the general muscular tissue. A similar attachment passes posteriorly from the cartilage between the pelvic bones, having attachment to the inner ends of their transverse ridges, with divergent connection to the integument covering the rays immediately under the point where the inner fin-rays appear upon the surface of the fish, from thence continuing some distance as a strong band down the centre of the belly. The pelvic bones are not always parallel with a line drawn through the centre of the belly, but are occassionally somewhat distorted, that is each forming a different angle with such central line.

The ribs from and including No. 15 & 22 are shorter in proportion than the others; this is in order to allow for the insertion of the pelvic bones, thus preserving the line of beauty. The space so afforded by the shortening of these ribs is 4 inches in length; (that is from the end 14 to 22,) the length of the pelvic bones being $3\frac{1}{4}$ inches, and from them to the extreme posterior end of the long fin-ray is $3\frac{3}{4}$ inches, making a total length of the fins and their attachments $6\frac{5}{8}$ inches average, allowing for the overlapping of the fin-rays upon the pelvic bones. It must however be borne in mind that the fin-rays owing to their curves, are of eccentric lengths, there being a difference in the measurements as they are taken from the dorsal or ventral aspects; in the lengths above I have taken the dorsal aspect in a straight line (not round the curve of the ray), the measurement of the ventral aspect of the same ray is $3\frac{1}{2}$ inches.

The ventral fins each contain 9 rays and each fin has a ventral appendage, in this case they are $1\frac{1}{2}$ inches in length.

1st. The first or outer ray divides at $1\frac{1}{4}$ inches from its attachment to the pelvic bones (that is visibly); on its ventral aspect it is attached to the pelvic bones by fibrous tissue and has a curved termination: on the dorsal aspect it curves strongly, forming a double heel each $\frac{3}{8}$ of an inch in length. The dorsal aspect is strongly attached by fibrous tissue to the outer head of the pelvic bone; and the inner heel is also embraced in similar attachment, together with the flat bony root of the ventral appendage (" axillary scale" of Dr. Gilpin), from the outer side of which passes a muscle into the general muscular tissue. From the outer heel a strong muscle is attached passing in the same way. It may here be mentioned that there is a strong band of muscular fibre passing forward from the ventral appendage, which, with its other muscular attachments, causes these appendages, when the ventral fins are in motion, to pass under them so as to protect the hollow which appears at the root of the ventral fin, preventing the lodgment of any floating material, such as sawdust or chips in what must be a sensitive part. As soon as the ventral fins are at rest these appendages withdraw themselves and lie parallel with their outer edge.

Dorsal aspect ventral:

1st. The first ray, measured in a straight line from heel to extremity, is $3\frac{1}{2}$ inches in length

2nd.	" second "	"	"	" $3\frac{1}{2}$	"	"
3rd.	" third "	"	"	" $3\frac{1}{4}$	"	"
4th.	" fourth "	"	"	" 3	"	"
5th.	" fifth "	"	"	" $2\frac{3}{4}$	"	"
6th.	" sixth "	"	"	" $2\frac{1}{2}$	"	"
7th. }	" seventh "	"	"	" $2\frac{1}{8}$	"	"
8th. }	*crowded.*					
}	" eighth "	"	"	" $2\frac{1}{8}$	"	"

The heel of the eighth is not like those of the previously mentioned rays, as its anterior end is very slightly raised towards the dorsal aspect, and slightly curved in opposition to the heels of the other rays; it passes very close to, and almost under the heel of No. 7 and near to the pelvic bone.

9th. The ninth ray has no heel on the dorsal side, but it has a slight upward curve in its line of direction tending towards the other rays, its length is $1\frac{3}{4}$ inches, its anterior extremity passes also close to the heel of No. 7 giving a crowded appearance to the last three rays, which are attached by strong fibrous tissue to the dorsal side of the inner ventral heel or broad plate of No. 9, which is turned inwards towards the outer side of the fin in opposition to the heels of the other rays (it being the only ray having this peculiar form) ; this broad plate is in its turn attached to the stout transverse process of the pelvic bone upon which its ventral surface moves ; in addition to this broad plate it has upon the ventral side the usual termination. The rays No. 2, to and including 8 are nearly of the same shape.

Ventral aspect, Ventral fin.

Here the rays, may, at their anterior ends be said all to curve towards the centre of the fish.

1st ray. The curve of the first ray fits upon the ventral aspect of the enlargement or head of the outer edge of the pelvic bone having very strong ligamentous attachment.

2nd. The second has the same attachment, its curved end terminating on the inner edge of the ventral aspect of the outer head of the pelvic bone.

3-9. The remaining rays have all a similar attachment, their anterior curves becoming less, until No. 9 is almost straight, and the ends of all gradually receding.

The dorsal heel of the 2nd ray is opposite to its ventral extremity, but the other rays gradually recede on the dorsal side until the anterior extremity of the 9th ray ventral aspect is one quarter of an inch in advance of the dorsal side of the same ray.

When the ventral fins are in motion or extended, all the anterior ends of the fin-rays appear closely crowded together, more so on the ventral than upon the dorsal aspect.

You may perhaps remember that in describing to you the dorsal aspect of the spinal column, your attention was drawn to two bones lying above the 57th centrum, covering it together with the 58th and 59th and partially that which may be called the 60th centrum, leaving on the dorsal aspect three centra unprovided with spinous processes ; on the ventral aspect your attention was also directed to a conical process different from all the other spinous processes which I said together represent in my view the pelvic bones. The bony plates to which are attached the ventral fins, together with the fins are usually called the pelvic limbs, but it appears to me there can be little doubt that the so called pelvic bones with the fins are the representatives of the hind legs of mammals, thus :

The saddle bones and the bone with the cup-shaped orifices below them, are the pelvic bones.

The centra without spinous processes, the sacral vertebræ.

The large hypural bone, the femur.

The pelvic bones, or the bony plates to which the fins are attached ; the tibia and fibula and the ventral fins generally the feet.

The Shoulder girdle and Pectoral fins.

At the junction of the body with the head under the opercular plate, appears on each side of the fish a series of bones forming the fore frame and support of its body, and from which spring at about two-thirds of their total length the pectoral fins. In the specimen of the salmon before you on their outer sides each set appears primarily to be formed of three bones. Reversing these bones and looking at their inner surfaces there appears to be on each division (right and left side) another bone now anchylosed with the posterior edges of each middle bone or inter-clavicle, and throwing off from their anterior edges a thin process or plate, which passes partially over the lower edges of the supra-clavicles and united to the anterior edge of each of the inter-clavicles, serving as a base for the supra-clavicles and for the attachment of their tissues.

Taking, as in the ventral fins, the shoulder girdle, left side—removed from the body of the fish, the upper portion the supra-clavicle viewed from the outside has a two-fold* termination, the posterior fork passes freely, apparently without any ligamentous† attachment, into the fleshy tissue ; measured in a direct line from base to point it is $2\frac{1}{4}$ inches in length, and its base is a little less than $\frac{5}{8}$ of an inch in breadth. It overlaps the inter-clavicle ; at $\frac{5}{8}$ of an inch from its base, anteriorly, arises

* Three-fold, if looked upon as the same bones in the cod are usually accepted.

† I could not find any in three specimens.

another process having a cartilaginous attachment to it, this process is somewhat irregular in shape and rough upon its edges for the attachment of the tissue which unites it to the bones of the skull. It penetrates beyond the marginal point of the pre-operculum and its tissues are connected with the edge of the supporting bone above the fleshy cheek behind the eye, in shape it is nearly straight, slightly curved laterally; from its junction with the supra-clavicle to its point it is about $1\frac{7}{8}$ inches in length; on the anterior edge of its projection or root this small bone is attached by cartilage to the bone which supports the operculum. To enable you to understand this junction I have cut off a small portion of bone from the skull leaving the cartilage entire. Let us turn this bone over and look at its inner face, at the point of junction of the small bone already noticed as supporting the upper portion of the supra-clavicle and diverging from it dorsally in a line with the centre of the root of the small or supra-clavicular bone, is a *short* bone having a very strong ligament connecting it with the skull bone at the base of the brain (it is this short bone which makes in the Cod fish the forked supra-clavicular bone, but it differs from the salmon inasmuch as it is throughout a bone and is not a representative of the process in the salmon which springs from the supra-clavicle), a pin in the skull of the large skeleton marks the point of connection.

Of the middle piece or inter-clavicle there need not much be said, it is as the supra-clavicle thin and flat and its upper end is inserted under the edge of the supra-clavicle, on its anterior face for nearly $\frac{5}{8}$ of an inch, posteriorly it has a thickened striated edge; its lower extremity which is flat, thin and oval-shaped overlaps and is attached to the clavicle, presenting the appearance of nearly concentric plates, the growth of which has taken place apparently from the inner side. In specimens freshly taken this bone has considerable freedom of motion upon the clavicle.

The Clavicle, Coracoid, Scapula, &c.

It is almost impossible for me to describe the shape of the clavicle and the bones connected with it, but I will make the attempt.

The clavicle from its inferior edge to the extremity of its anterior horn is in this specimen :—$2\frac{3}{4}$ inches in height ; $3\frac{3}{4}$ inches in length, from posterior to anterior end, and measured on a line through its centre ; the inter-clavicle is attached to it for about $1\frac{1}{4}$ inches, measured from the top of its anterior horn, and the shape of its superior extremity nearly corresponds to that of the inferior extremity of the inter-clavicle ; on its inner side, near its posterior edge, there is slightly projecting from it a thin bony plate, terminating at the lower edge of the clavicle to which it is anchylosed, it has a narrow rounded end, this unites with the posterior edge of the accessory bone—its lower rounded end is close to it. The accessory bone arises about midway on the posterior edge of the clavicle, at the junction of the division of its thin posterior plates, and is anchylosed with it ; it becomes gradually thicker for nearly one third of its length and then decreases to its inferior end where it has the usual enlargement for its attachment to the strong muscular tissue in this part of the fish, its interior edge projects $1\frac{1}{8}$ inches below the clavicle, and its posterior edge $\frac{7}{8}$ of an inch. This accessory bone passes inside of the pectoral fin, and gives support to it ; it is entirely different from that of the cod-fish in shape as well as attachment. In the cod, as you will see by the specimen (pectoral fin, clavicle, etc., shown), it is a free bone, lying loosely upon the upper posterior edge of the clavicle.

The scapula joins at its superior extremity the upper edge of the clavicle, and its inferior extremity the upper posterior division of the coracoid bone ; its posterior inferior extremity is also attached by cartilage to the posterior edge of the bones, which represent the radius and ulna.

The coracoid at its posterior extremity is divided. Its upper edge is united with the scapula, as already mentioned ; its lower limb, which is the longest, has its point attached to the inner central ridge of the clavicle, and it is pierced by two foramina, each of considerable size, one on either edge, outer and inner, the latter being the largest and oval in shape ; the posterior edge of this lower limb is united by a band of very thin bone, which follows on the one side its shape, and on the other the outline of the two nearly circular bones which represent the radius and ulna. The anterior extremity of the coracoid is somewhat twisted, that is, its inner and superior edge rises for its union by cartilage with the clavicle, which sends out from its central ridge a flat process for this purpose.

The Humerus,

If you will look at the under side of the coracoid bone, which on this aspect appears to be nearly flat and somewhat curved, from its posterior extremity to its junction with the clavicle; between the foramina already noticed you will perceive a central ridge, which expands towards its posterior extremity ; about midway of its length there appears to be a transverse joining, or symphysis, and following this ridge posteriorly you will see that one edge of it forms the outer side of the inner foramen, and that there is a line or indentation which passes by the edge of the outer foramen to the transverse division from whence we started, this appears to me to be, without doubt, the humerus, but to be positive on this point requires the examination of very young specimens of the salmon, which I regret to say my sight will not permit me to undertake.

Carpal Bones and Pectoral Fin.

The pectoral fin is attached to four ossicles, or carpal bones, with the exception of the upper or long ray, which is directly articulated with the radius—the upper one of these ossicles and the shortest is attached to the ulna ; the three lower to the posterior extremity of the coracoid, at the lower part of the bone which I regard as the humerus—all cartilaginously. The lower ossicle is $\frac{3}{4}$, the upper about $\frac{5}{16}$ of an inch in length.

The rays of the pectoral fin are fourteen in number. The first or upper ray is in length, from attachment to posterior extremity or point, $4\frac{3}{8}$ inches, the others gradually decreasing in length until the lowest and shortest is $1\frac{3}{8}$ inches. Looking at the fin on either side the rays are crowded, and set one within the other after the manner of a venetian blind when turned to keep out the rays of the sun, the inner inferior margin being the lowest. The upper or long ray, at its attached extremity is very much stronger than the others, and at this point it has a wide articulating surface on its inner side or heel for its union with the radius upon which it moves, this surface is furnished with the usual lining and ligaments of such joints; from its inner to outer heel transversely it is in breadth $\frac{5}{8}$ of an inch.

Outer side of the pectoral fin.—The heel of the first or upper ray is $\frac{3}{8}$ of an inch in length, and nearly at right angles to its shaft, the heel inclining away from its supporting bone, and at the same time turned towards the ventral aspect of the fish. The heels of the remaining rays gradually increase their angles or have less abrupt curves until the last two or three rays, when their curves again become sharper, the lengths of all decreasing, but the outer heel of the lowest or short ray preserves nearly the normal shape, and projects an $\frac{1}{8}$ of an inch below the supporting ossicle. On its inner side the heel of the lower ray is very stout, and its edge inclining downwards gives it a broad termination for the accommodation of the articular joint. The heels of the next six rays gradually decrease in their length and curves until the 8th ray is nearly straight; 9th, 10th, 11th, 12th and 13th rays are also nearly straight, but closely crowded together, and the inner heel of the 14th is curved upwards and almost overlaps the end of No. 13; the outer heel of 14 is, from outside to outside, $\frac{1}{4}$ of an inch below the inner extremity. All the rays are on each side attached to the base of the fin, by strong cartilage, which fills the division of or the space between the rays, so much so that without destroying the fin, which at present cannot be spared, it is impossible for me to give a more particular description of it.

At the junction of the clavicles, which are connected by cartilage and closely attached to their united ends by strong fatty tissue, is the urohyal bone, in this specimen it is $1\frac{3}{4}$ inches in length, and $\frac{3}{4}$ of an inch in height at its posterior extremity; at this point begins its ventral transverse plate, for half an inch of its length it is very narrow, but it rapidly widens until it attains $\frac{3}{8}$ of an inch, taking a lanciolate form. This bone is perpendicular to the body of the fish, and by its anterior end it is attached to the hyoid bones.

This brings us now to the head of the fish on the ventral aspect, and my present task is done. I have endeavored to describe to you the bones of the salmon (*Salmo-Salar*) as they appear to me to be. I have no theory to advance or support, and it is too much to expect that in what I have read to you there is no error, but it may serve to help some enquirer on his way, and if such be the result my time will not have been spent in vain·

Art. VIII.—Nova Scotian Fungi. By J. Sommers, M. D.

(*Read Jan.* 26, '80.)

The present paper affords a very short list of some of the more common species of our mycological flora, the result of a three months' study of a local botanical region.

During the time very many specimens have passed through our hands. Difficulties in diagnosis, want of sufficient time, and the evanescent characters of many of them, have been important factors in determining the length of our list, but we have observed enough to convince us that the fungi are capable of affording a field for study which will take many years of patient and laborious investigation to render complete.

Viewed either from scientific or economic point, the fungi furnish us with interesting matter for study and comparison Their organization, growth and reproduction afford matter for originality in their treatment by scientists. Their Medical and nutritive properties—their parasitical end destructive tendencies supply matter for reflection on the part of the economist.

To the student of nature they are of interest, as situate on the border line between the dead and living things of earth—maintaining the balance of power, devourers of dead organic matter, destroyers of decaying organisms ; they supply, also, a bountiful store for hosts of highly vitalized, organized beings, and are not even disdained by man himself.

The local peculiarities of our Province now existing, viz, its dense woods and extensive swampy barrens, fnrnish favourable conditions for the development of this class of vegetable, which our dry atmosphere would, under other conditions, seriously interfere with. The progress of arts and agriculture in the future, will with them, as in the case of our higher indigenous plants, cause their disappearance, the present is therefore the time to classify them and record their existence.

ORD. I.—AGARACINI.

SERIES—Leucospori.

SUB. GEN.—Amanita.

1. Agaricus (Amanita) vaginatus, *Bull.* Under hemlock and pine, N. W. A., Hx. Sept.

2. Agaricus (Amanita) adnatus, *Smith.* Under spruce; Point Pleasant, Hx. Sept.

3. Agaricus (Amanita) muscarius, L. Not uncommon in same situation as above. September and October. Poisonous.

SUB. GEN.—Tricholoma, Fr.

4. Agaricus (Tricholoma) columbetta, *Fr.* Park woods; under spruce. Oct.

5. Agaricus (Tricholoma) crassifolius, *Berk.* Under spruce. Park woods. Oct.

SUB. GEN..—Clitocybe, *Fr.*

6. Agaricus (Clytocybe) laccatus, *Scop.* Common in most situations. Aug. to Oct.

SUB. GEN.—Colybia, *Fries.*

7. Agaricus (Collybia), dryophilus, *Bull.* Point Pl. Park, Hx. Oct.; on decaying leaves, etc.

SERIES—Dermini, *Fr.*

SUB. GEN.—Naucoria, *Fr.*

8. Agaricus (Naucoria) nuceus, *Bolt.* In the Park woods; under spruce fir. Oct.

9. Agaricus (Naucoria) pediades, *Fr.* In open spaces. Oct.

SUB. GEN.—Galera, *Fr.*

9. Agaricus (Galera) ovalis, *Fr.* On cattle droppings in woods. Nov.

SERIES—Pratellæ, *Fr.*

SPORES—Purple or intense Brown.

SUB. GEN.—Psalliota, *Fr.*

10. Agaricus (Psalliota) campestris, *L.* Everywhere in cultivated land, and pastures. Common mushroom.

SUB. GEN.—Pilosace, *Fries.*

11. Agaricus (Pilosace) eximius? *Peck.* On a decaying log; the Dingle, N. W. A., Hx. Sept.

SERIES—Coprinarii, *Fr.*; Spores Black.

SUB. GEN.—Psathyrella, *Fr.*

12. Agaricus (Psathyrella) gracilis, *Fr.* On cow droppings. Sept. In pasture; Dutch Village.

GENUS—Coprinus, *Fries.*

13. Coprinus micaceous, *Fr.* Common on dung and compost. Aug., Nov.

GENUS—Cortinarious, *Fr.*

SUB. GEN.—Dermocybe, *Fr.*

14. Cortinarious (Dermocybe) cinnamoneus, *Fr.* In grassy spaces in the Park, Hx. Sept

GENUS—Lepista, *Smith.*

15. Lepista personata, *Fr.* Park woods, Hx. Sept.

16. Lepista cinerascens, *Bull.* Under spruce and pine; Park Oct.

GEN.—Hygrophorus, *Fr.*

17. Hygrophorus eburenus, *Fr.* Stem swollen; volva persisting; pileus 4½ inch. Under pines in the Park, Hx. Oct.

GENUS—Gomphidius, *Fr.*

18. Gomphidius glutinosus, *Fr.* Common about Hx. Sept. and Oct. Growing on the soil.

GENUS—Russula, *Fr.*

19. Russula vaternosa, *Fr.* Pine grove; Pt. Pleasant. Sept.

20. Russula alutacea, *Fr.* Under pines; Point Pleasant, Hx. Nov.

GENUS—Marasmius, *Fr.*

21. Marasmius oreades, *Fr.* "Fairy-ring champignon." Border of woods and roadsides. Oct.

GENUS—Schizophyllum, *Fr.*

22. Schizophyllum commune, *Fr,* On dead wood; common. Aug.

GENUS—Lenzites, *Fr.*

23. Lenzites betulina, *Fr.* Common on birch and stumps; perennial.

ORDER—POLYPOREI.

GENUS—Boletus, *Fr.*

24. Boletus lividus, *Fr.* Common. Poisonous. Aug. to Oct.

25. Boletus pachypus, *Fr.* In woods ; common. Aug.

GENUS—Polyporus, *Fr.*

26. Polyporus fomentarus, *Fr.* On birch ; near Truro, N. S. July.

27. Polyporus annosus? *Fr.* On fallen hemlock trunk ; near Truro, N. S. July. Persistent, pores? rich umber brown ; margins velvety, of a deeper shade ; cuticle dense, sooty, spotted or indefinitely marked ; slate colored ; consists of two masses, both provided with pores, etc., one resting above the other, but forming one substance, attached ? its whole length at one side ; body of upper mass extends one inch beyond the lower, the free under surface of this mass provided with pores like the lower one ; margins sinuous ; pileus about five inches in width, by three inches in thickness ; length, about four inches ; very solid ; woody ; the two masses, viewed as a whole, resemble an agaricus with a very thick stipe ; width of lower portion, three inches ; thickness, three inches ; length, about one and one-half inches. I give its characters in detail, because my diagnosis is a doubtful one.

28. Polyporus versicolor, *Fr.* Resupinate ; persistent ; common. On larch, hemlock, birch, etc.

ORDER—HYDNEI.

GENUS—Hydnum, *Linn.*

SECT.—Mesopus.

29. Hydnum rapandum, *L.* Near the roots of pines. Point Pleasant Park, Hx. September.

GENUS.—Sistotrema, *Fr.*

30. Sistotrema confluens, *Pers.* In the Park. Oc.

ORDER—PHALLOIDEI.

GENUS—Cynophallus, *Fr.*

31. Cynophallus caninus, *Fr.* Found by Mr. R. Morrow in a drain on his property.

ORDER—TAITHOGASTRES.

GENUS—Lycoperdon, *Tourn.*

32. Lycoperdon cœlatum, *Fr.* Common in pastures. Aug., Sept.

33. Lycoperdon gemmatum, *Fr.* In fields and pastures. Common. Aug., Sept.

ART. IX.—NOVA SCOTIAN GEOLOGY.—NOTES ON A NEW GEOLOGICAL PROGRESS MAP OF PICTOU COUNTY. BY THE REV. D. HONEYMAN, D. C. L., F. S. A., *Hon. Member of the Geol. Assoc., London, &c.; Curator of the Provincial Museum, and Professor of Geology in Dalhousie College and University.*

(*Read May*, 10, 1880)

INTRODUCTION.

The map exhibited is the first of a series which I have been engaged for some time constructing.

They are all on a scale one inch to the mile. Church's county maps are generally used for topography. Occasionally the Admiralty charts are used in the delineation of harbours and portions of coasts of geological importance. From these and railway section books elevation measurements are largely obtained.

The various papers that I have submitted to the Institute and these maps may be regarded as mutually illustrative.

Additional notes, however, seem to be required, in the case of some maps, for the following among other reasons :

1st. Railways have been, or are being, constructed which are of more or less geological importance. These, in their nature, could not be referred to in papers already communicated.

2nd. New facts may have come to light.

3rd. Certain old facts may have to be brought into connection with these new facts for specific purposes.

The following notes on the progress map of Pictou county seem to be required on considerations as above.

GREAT COAL FIELD.

A prominent feature of our map is an irregular polygon colored black. This is the Pictou coal field as defined by Sir W. E. Logan and E. Hartley. I have simply transferred it from the map accompanying the Report of Progress of the Geological Survey of Canada, 1868-9.

Eastern Extension Railway.

I am indebted to M. Murphy, C. E., Government engineer, for the correct delineation of this line of railway on my map. Passengers cannot fail in observing the great scarcity of rock cuttings along the line from New Glasgow to the eastern boundary of the county. Still it has been the means of reaching many points of interest to the geologist, and it has rendered of easy access a district of great interest, whose geology has been imperfectly comprehended and partly misunderstood.

Leaving the New Glasgow station, we start from the northern side of Sir W. Logan's coal area, traverse the lower carboniferous conglomerate of New Glasgow and succeeding grits. Turning eastward we proceed through drift cuttings and occasional sandstones while crossing Sutherland's River and French River. We continue to traverse the Lower Carboniferous through Piedmont Valley. Entering the basin of Barney's River the geology begins to be somewhat obscure. In fact, we are taking a great geological leap. When we pass from the Barney's River strata to the siding at Dewar's furniture factory, we find that we have descended from the Lower Carboniferous to the Middle Silurian period. The geological gap between represents Devonian and Upper Silurian time. We have just crossed the Western branch of Barney's River. Proceeding a short distance we cross a bridge over the middle branch, descending lower in Middle Silurian time. Still farther on we cross the eastern branch of Barney's River. Here strata are seen partly covered by a *dump*. These are the bottom strata of this Middle Silurian series of the several branches of Barney's River. The Middle Silurian series here, as elsewhere, includes A, B and B′ of the "Upper Arisaig series." A is equivalent to the "Mayhill Sandstones" of Wales, according to Salter. B′ is of Clinton age, U. S., according to Hall, and B intermediate, according to my own determination, of the typical series in Arisaig Township of Antigonish County. I may state that B′ is the "Lower Arisaig series" of "Acadian Geology." Still proceeding on the line of railway, we pass from the base of the Middle Silurian to a base of strata of Lower Carboniferous age. We thus take a greater leap upwards than was done downwards on our entering upon the Barney's River Basin. The difference is measured by our descent geologically in passing through the Middle Silurian series. Proceeding onward we pass from the Lower Carboniferous into a great Metamorphic series which enters largely into the constitution of the mountains through which passes the remarkably picturesque "Marshy Hope."

Through this pass flows the eastern branch of Barney's River and proceeds the line of Railway, in two sub-parallel lines.

A beautiful section of a part of the metamorphic strata is seen on the side of the railway. The latter proceeds onwards, through the valley without any other rock exposures being apparent. About a mile from the county line, strata A, (Middle Silurian) are observed on the side of Barney's River. These extend onward into the County of Antigonish, and are cut by the railway before it reaches the county line. We discontinue our journey until I read notes on the map of Antigonish County.

General Sections.

On the map.

Section line, No. 1.—This section commences on the Pictou and Antigonish Co. line, 2 miles from Northumberland Strait and the same distance from the N. west corner Arisaig Township, the county line being the western boundary of the township. The portion indicated is 3 miles distant from the top of the uppermost member (D) of the typical " Upper Arisaig Series," situate near the mouth of McAra's Brook in the county of Antigonish, and on the Northumberland Strait. This line is *zigzag*, consisting of three straight lines, which I shall designate respectively 1, 2, 3.

Line 1.—Beginning at the starting point proceeds in a direction S. 25 W. to Sutherland's Mountain, *Kenzieville*, a distance of 9 miles. In it course it traverses, 1st. The metamorphic rocks of the Antigonish and Pictou Mountains. 2d. A carboniferous band of rocks of the same mountains. 3d. A. B. & B'. of eastern and middle branches of Barney's mountains, and ends at strata with Diorite, of Sutherland's mountain at the west branch of

Barney's River. I have already incidentally referred to some of the rocks of this section. Having recently made a thorough examination of the Basin of Barney's River, I shall give the results.

Traversing the line of railway, I was led to make Dewar's Furniture Factory siding my halting place. Here I was kindly welcomed and hospitably entertained by the proprietor of the Factory. Examining the dam and race which are situate on the west branch of Barney's River, I was interested to find *Silurian strata* where I had expected to find Carboniferous rocks. From cursory observations I had been led to infer that this was a Carboniferous area, and that the Silurian of the east was bounded by the eastern branch of the River. I had supposed Cameron's mountain which was on the right of the road entering the Marshy Hope, which is formed of lower carboniferous conglomerate, to be a continuation of the carboniferous mountains which run on the south Piedmont Valley. I had also supposed that the Middle Silurian strata (A) which occur on the left side of the same road was a continuation of other strata, occurring in the Marshy Hope at the county line. *See the railway traverse* proceeding.

Accompanied by A. Dewar, I examined the fields to the south of the factory onward to the New Glasgow and Antigonish road in search of the supposed connection of the Carboniferous Mountains without success. We then observed Silurian strata in the middle branch, which led us to follow its course northward to the railway bridge. We found Middle Silurian strata (B) all the way, and, therefore, *no connection* between the Marshy Hope Carboniferous Mountain and the Mountains of the west. We then ascended McPhee's Mountain on the north side of the entrance of the Marshy Hope and found that it also was formed of Lower Carboniferous Conglomerate, like Cameron's, on the south. We afterward examined rocks in the east branch of Barney's River and found that they were the connection between the two mountains, being also conglomerates with the addition of *igneous* rocks. The latter were found to occupy a *central* position, by comparison with the other passage conglomerate outcroppings on the road. The continuation of these mountains on the north was also found to be of Lower Carboniferous age, Cameron's mountain is there connected with the Carboniferous of Merigomish, on the north rather than on the west. It then appears that the metamorphic rocks of the Antigonish and Pictou mountains are *altogether* bounded on the west by Carboniferous rocks of mountains. It at the same time appears that the Middle Silurian (A) strata, on the left side of the road, are completely disconnected with the similar strata (A) toward the county line. These are two note-worthy considerations.

I shall now direct attention to the disconnected Silurian strata. They are brownish quartzite slates, much metamorphosed. They are fossiliferous. The fossils are the usual ones of A of the "Upper Arisaig series." *Petraia, Athyris, Cyclonema.* They are all casts—external and internal. On the east branch of Barney's River, where the railway enters the Marshy Hope, I have referred to similar strata partly covered by a *dump.* These lie to the north of the preceding, and are also cut off from any connection with Eastern Silurian strata by the carboniferous conglomerates and igneous rocks of the same branch of Barney's River. We are thus led to follow a northern course, i. e., down the river. We find them proceeding in this direction, crossing the river at McPhee's, and apparently terminating $3\frac{1}{4}$ miles from the entrance to the Marshy Hope. I collected fossils in part of these at the road before reaching McPhee's. Two of the specimens lie before me. I shall describe them. The one is a quartzite rock, coloured brown with iron oxide. It has a sharp cast of the exterior of a good sized *Cyclonema.* One side of the specimen has crystals of quartz. The second specimen is of the same character, being from the same mass of rock. It is larger, having a vein of quartz with beautiful quartz crystals. On a corner is exposed a large *Cyclonema,* showing the internal cast entire, also a considable part of the surrounding external cast. The shell space is entirely vacant. The last specimen is a beautiful and convincing illustration of *rock formation.*

Examining the high ground south of the Marshy Hope road and west of Cameron's mountain of lower carboniferous age, referred to above, we found the southern continuation of our Silurian (A) strata outcropping extensively ; after a time it ceases to appear.

We proceed onward to Mr. McIver's at the back of Cameron's mountain, no outcrops appeared. We then descended McIver's Brook proceeding northward, no strata were seen for a considerable distance, at length strata appeared in great mass which were found to be our Silurian (A) strata succeeded by B crossing the brook to proceed westward as mountain strata, including Sutherland's mountain of our section. Their boldness, and hardness of A, have constituted them mountain rocks. Sutherland's mountain strata are tilted; fossils abound in them, such as Arisaig, and quartz veins are also abundant.

A great proportion of the mountain consists of Diorite. It is well exposed on the back of the mountain reaching nearly to its summit. This is the usual association in Nova Scotia, east and west. In Antigonish, Pictou, Annapolis and Digby counties, strata A of the upper Arisaig series are invariably associated with intrusive Diorite. Succeeding this band are B. & B′ strata, these contrast strikingly with the preceding. They are generally very soft furnishing the *pencil stone* of *How's Mineralogy of Nova Scotia;* when exposed they become clay. The lower strata contain my "Lingula nodule bed." As usual at my last visit I extricated a great number of nodules from its two exposures. These contain beautiful *lingulæ* of several species. B′ strata as usual furnish a great variety of genera and species peculiar to our Clinton period. They will be found included in our *lists of fossils* in the sequel. The west branch of Barney's River is the approximate boundary of this Middle Silurian area. The Carboniferous begins in the river at the mill north of McPhee's Silurian (A) strata. At Dewar's Furniture Factory strata B extended beyond the river. Between Robertson's and the Rev. Mr. McKeehan's, the carboniferous mountains south of Piedmont Valley, have their extremity on the east. This apparent intrusion into the Middle Silurian originally led me to infer a connection with Cameron's mountain already referred to.

Antigonish and Pictou Mountains.

From McPhee's extremity of A (Middle Silurian strata) I crossed the Middle Silurian and then the Carboniferous, and reached the old mountain road at Bailey's Brook. At the bridge and fulling mills ruins, Igneous rocks were observed, of lower carboniferous age.

A short distance above the bridge I examined a mass of limestone of lower carboniferous aspect. J. McLellan who pointed it out to me, assured me that similar limestone had been quarried in the high ground to the east of the mountain road and used for building purposes. Farther on the road side and mountain sides and summit, outcrops of metamorphic rocks appear, they are quartzites and argillites. No member of the Upper Arisaig series has thus far been seen on the side of this metamorphic series. The carboniferous bands extend from the Antigonish county line to the Marshy Hope road. We shall now examine the south on Marshy Hope side. On the road below W. Robertson's and at the watering place for horses, the felsites of the mountains appear after the carboniferous outcrops, on the left side of the line of railway opposite. At Pushie's is an interesting section of a steep side of the mountain, the rocks of this section are felsites and argillite, the felsites containing *micaceous hematite with pyrite.* Beyond this, there do not appear any rock exposures until we come opposite the Marshy Hope station. Here at a bridge over Barney's River, of the road entering the Sutherland settlement, Middle Silurian strata (A) outcrop. Entering the settlement we find argillites with quartzites on the side of a tributary of Barney's River. On the summit of the mountain at Sutherland's, Argillite outcrops. These resemble the James River Fall rocks. The latter are in Antigonish county—9 miles east, from the Sutherland mountain outcrop. The Middle Silurian (A) strata of the bridge extend into Antigonish county as far as Lindsay's stables. At McLean's they are cut by the line of railway, after this the railway passes them on the south. I discovered these many years ago. *Lingulæ, Petraia and Cornulites* were also found in them from time to time. I was accompanied by the Rev. Mr. Goodfellow and his son, when I made my recent examination. We found *Petraia forresteri* (Salter) in the *strata* at Lindsay's stables. At McLean's we found abundance of *Cyclonema, Orthis and Lingula* associated with the characteristic *Athyris* (casts) and *Crinoidea.* From the mountain side above, Mr. Goodfellow brought a piece of rock which was found to be a conglomerate of peculiar character. It is almost identical with the dioritic conglomerates which I found at Wentworth, I. C. R., with other conglomerates and rocks, which led me to proper views of the age of rocks of the Arisaig mountains, and to distinguish them from the "Lower Arisaig series," (Archæan, Dana) and "Upper Arisaig series," (Middle and Upper Silurian,) by making a "Middle Arisaig series" and correlating it with Professor Ramsay's "Cader Idris" (Lower Silurian). The distance from the north side of Bayley's Brook to the south side McLean's is 5 miles.

Other Mountains.

My attention was also directed to the mountains on the south side of the Marshy Hope railway. Opposite the Middle Silurian (A) strata last examined, is a Brook (Bryan Daley's) which penetrates these mountains. Ascending this brook the first rocks that I met with were apparently carboniferous strata consisting of clayey shales and conglomerates. Succeeding these are exposures of metamorphic slates — argillites. I shall have to investigate these before I can arrive at any satisfactory conclusion regarding their age. In the meantime I regard them as a continuation of whatever rocks may form the mountains at McIver's, and, therefore, as underlying the strata A, B of the Barney's River Middle Silurian area. The same, doubtless extend farther west behind Sutherland's Middle Silurian Mountain of our section, so that they may be regarded as *Pre-Middle Silurian* and therefore, *Lower Silurian.*

Section line 1, division 2 extends from Sutherland's Mountain to French River—a distance of 9 miles. Its course is N. 80 W. It begins in the diorite of Sutherland's mountain, crosses A strata of the mountains, passes through B strata with its *Lingula nodule bed,* traverses B' south of Cooper's and at Turner's with its Graptolithus clintonensis (priodon), Dalmanites Leptocœlia, Strophomena, etc., and ends at an igneous rock in French River (a Lower Carboniferous rock).

This Middle Silurian area is intersected diagonally by the line of section. It is bounded on the north by the Carboniferous mountains—these have been already referred to as on the south of Piedmont valley and the line of railway. The mountains on the south are an extension of the strata of Sutherland's mountain. Strata B and B' lie between.

Division 3 extends from French River to the west side of Irish Mountain, a distance of twenty-seven and a half miles. Its course is S. 55 W. It traverses first an area of Lower Carboniferous rocks, then the Middle and Upper Silurian of Sutherland's River, McLellan's Mountain and Brook, and Irish Mountain, terminating in the Lower Carboniferous of East River.

The Silurian formation retreats after it reaches the west branch of French River, and forms the compound curve which connects the Silurian area of the Barney's and French basins with those of East River basin. The connection is very complicated, consisting of Anticlinals, Synclinals and Monoclinals; yet there is no great difficulty experienced in resolving the complications in consequence of the constant recurrence of well known characteristic fossils and obvious structure. Vide Papers in Transactions 1870-1-2.

Section 2nd.

This section begins where the preceding section ends. Division No. 1 proceeds S. 19 E., a distance of 4.3 miles to Fraser's (sadler). Beginning in the Gypsum it passes through the Lower Carboniferous to the Limestone of McLean's Lime Kiln at Springville, a little farther it enters D strata, with abundance of characteristic fossils. At the late Rev. Angus McGillivray's pasture, it enters C strata with fossils characteristic of this horizon. It then passes through an obscure region, in which we may presume that B′ (Middle Silurian) strata are to be found according to the analogy of the preceding section (No. 1). We then come to a hill having fossils, which show that C strata have been left behind. Reaching Fraser's (sadler) we come to the *first discovered outcrop* of the iron ore of this division, or series, which we would, for future reference, name *Iron Ore*, No. 1, Division No. 2 of the section running N. 59 E., 0.6 of a mile, passes through the lowest strata of this series, which we shall, in the meantime, designate A strata. It then traverses a wide dyke of igneous

Diorite. Division No. 3 runs N. 82 E., a distance of 2.2 miles to John McDonald's Hill, Blanchard, passing through Middle Silurian strata A. At McDonald's hill it cuts an interesting outcrop of D strata (Upper Silurian) with characteristic fossils. Division No. 4 passes N. 59 E., a distance of 0.6 of a mile, at its termination it cuts the Blanchard Iron Ore. This is a bed of fossiliferous red hematite 30 feet thick. The ore and the containing strata have fossils characteristic of A (Middle Silurian). I will call this *Iron Ore, No. 2.* Division No. 5 runs S. 45 E., a distance of 3 miles. The half of this distance, 2.5 miles, it passes through Middle Silurian strata and then it reaches crystalline metamorphic rocks of Archæan age (Lower Arisaig). It traverses these a distance of 2.5 miles to McPhee's, still on the north side of East River Division. It continues in the same direction S. 45 E., a distance of 0.6 of a mile, crossing the river and passing into a band of black metamorphic Middle Silurian strata These have an east and west strike. At a farther distance of 6.8 miles, west, we reach the first outcrop of Iron ore at McDonald's due south of Blanchard. I shall name this *Iron Ore No. 3.*

Remarks on the Division of Section Line No. 2.

Division 1.

The series of Silurian rocks of this division might be regarded as a typical series, if Arisaig did not put in a prior and superior claim. I shall consider the series of Springville in the order of its development. D strata at McLean's have received the most attention on account of the abundance of fossils. The fossils and their order of occurrence correspond in a striking manner with the typical D at Moydart, Arisaig Township.

The fossils are, with a few exceptions, of the same order, genera and species ; the mode of their occurrence and association remarkably corresponds. A ledge on the height at the back of McLean's and to the north of David's lake, has precisely the same fauna as a corresponding ledge at Moydart. The fauna are *Cornulites flexuosus, Homalonotus dawsoni, Spirifer subsulcatus* and *Avicula honeymani,* associated and in abundance. The only difference is in the degree of metamorphism and in the state of preservation. All the strata of the series of Springville are more highly metamorphic than in the type, and the fossils, generally, are less perfectly preserved. C strata here correspond and differ in like manner when compared with the typical strata at Knoydart, Arisaig Township. The *Cephalopoda* are as large as in the type. An orthoceras at Springville is the largest found in Nova Scotia. Similar species appear in groups, as in the type. They occur in the same relative position. Remarkable forms are also found in the two localities. Here the strata are more highly metamorphic. This action has also affected the state of preservation of the fossils. They are generally casts. Strata D may be regarded as extending from the north end of Irish Mountain to Holmes' Brook. Before reaching McLean's, however, they seem to break and their course to change. At Mackintosh's brooklet they make a sort of water-fall, near their junction with the Carboniferous Sandstones that underlie McLean's Limestone. From this brook to Holmes' brook we have the D strata of division (1). Their width is considerable. Their outcrop, with fossils, was followed to some distance behind David's Lake. At the back of Irish Mountain C strata possibly exist among the strata of the abrupt descent to Cross Brook. They were not detected from want of fossils. At Holmes' Brook their upper part becomes distinct in closest contact with Lower Carboniferous Limestone. Their immediate contact forms a breccia. Here the water sinks, leaving the remainder of the brook dry in summer. The water that has disappeared after a subterranean flow, reappears at Holmes' sluice and flows *sub diu* to the river. Limestone and C strata are seen in approximate contact at the opening; in the strata east of the sluice the large orthoceras was found and other characteristic fossils. In an outcrop not far from the road crossing, on the same side of the sluice, other characteristic fossils were found. The *same strata* are found in contact with the limestone on the river side at McPhee's. These strata passing along N. E. on the N. side of the river form mountains of steep ascent and considerable elevation. In some places the strata are bare, especially towards the mountain summit, resembling a house top of *high pitch.* The lower strata of McGillivray's pasture continue their *rampart* course with a depression on the left onwards to the end of the mountain, having the same characteristic fossils at the end as at the beginning; limestone is seen here in the river as at McPhee's although not in contact with the strata.

A RED LETTER DAY IN THE HISTORY OF PICTOU AND GEOLOGY OF DIVISION C.

On the top of a hill at the end of the C strata mountains, on the line of the depression of the mountain summit already observed, on the right of the McGillivray strata I found an exposure of strata lithologically distinct fron D & C. These so much resemble the B' strata of Doctor Brook, Arisaig Township, that I was led to search in them for fossils. This happened on a day ever to be remembered in Pictou, when H. R. H. the Prince of Wales was in Pictou *en route* to Prince Edward Island. Few were in the country that day who could find the ways and means of getting to the town, these not being available I continued my search for fossils and found them. I collected 4 specimens belonging to a new species of Homalonotus which is known in my collection as *Homalonotus Siluriae Principis*—Prince of Wales Homalonotus, two large *lingulæ* were discovered also a *discina* and a form, *Incertae sedis.*

DESCRIPTION.

C and D strata as at Arisaig have each their characteristic homalonotus. The number of specimens of a species of homalonotus found in our new strata of the mountain seems to form a characteristic. *Homalonotus dawsoni* is characteristic of D. *Homalonotus salteri, M. S. is characteristic of C.*

This was considered by Salter from the appearance of the pygidium to be Homalonotus *delphinocephalus.* When examined by him the head of the form was unknown. Specimens of the head were afterwards found which showed that it is not *delphinocephalus.* I have regarded it as a *new species* and named it after the late distinguished Palæontologist of H. M. Geological Survey of Great Britain.

The thorax and pygidium are all that is known of the *Homalonotus Siluriae Principis.* The thorax has the character of the genus, being *level backed*; the pygidium is different from that of *Homalonotus salteri* in not having a terminal spine. From this and *Homalonotus dawsoni* it differs in being distinctly *trilobate*; the others have their furrows deep and continuous from side to side; this has the side *furrows* coming opposite to the *ridges* of the axis. It is much stouter than the others. The specimens are more or less distorted by metamorphism, the containing strata being highly metamorphic.

The first appearance of homalonotus in the typical Arisaig series is in B', where it is associated with casts of *pentamerus oblongus.*

This leads me to refer the strata in question to B'. The association of the large *lingulæ* seems to indicate the same horizon, as they are found in the same position at Arisaig. These are the only lingulae found as far as I know at East River. Discina is larger than discina of D Springville ; it more resembles the discina of B', French River. The form referred to *incertæ sedis* resembles the valves of a *pholas* open. It is finely striated across.

These considerations led me to consider the mountain strata as the upper part of B′ of the series.

On the McLellan's mountain road, at the back of McGillivray's is a deserted farm, succeeding an obscure forest area. Here I observed strata which resemble fossiliferous A strata highly metamorphic. I did not succeed in finding fossils in them. I found a *petraia forresteri* in the bed of Holmes' Brook which might have come from a part of these strata, as this brook passes not far from the said *old farm.* The strata of this farm extended in the line of strike, cross the section line near the position of *Iron Ore No. 1.*

This Iron ore is now an old acquaintance. It is 25 years, less six weeks, since I was first introduced to it by the late Rev. A. McGillivray. Then it was scattered all around his mountain farm. Every cairn of stones had its large masses and small pieces of beautifully crystallized brown Hematite. This led Mr. McGillivray naturally enough to suppose that the vein of ore was situate within the bounds of his farm, and that its discovery would add to the value of his property, especially as the General Mining Association was supposed to have no reservation except for *Gold, Silver, and Lapis Lazuli.* Every year, about the same season, we had a search for the hidden treasure. In 1869, after a freshet, I considered that I had found unmistakable evidences of its position, near the upper outcrop of strata C. In apparently the same position, I came upon the trenches of the General Mining Association, at the end of the C. Strata Mountains, with a great accumulation of masses of ore on the sides of the road, near the bridge that crosses East River.

This led to the conclusion that the vein traversed *Aymestry Limestone* strata. In 1864, when making a preliminary Geological survey for the N. S. Government, *vide Blue Book* Fraser's ore was pointed out to me in a small brook. There was not the least difficulty in recognizing this as approximately *in situ*. Mr. E Hartley, of the Geological Survey of Canada, sank a pit here and found the ore *in situ*. Considering the strata of Fraser's site as Middle Silurian I was only perplexed by the indications, and led to the conclusion that we must wait until the vein was traced from Fraser's onwards.

I am just waiting for an opportunity of examining the course of Mr. Gilpin's excavations, to satisfy myself in reference to the course of the vein, so as to indicate its Geological relations on the map.

The carboniferous approaches the river on the south side opposite Fraser's, as is indicated by limestone or gypsum pits. It likely overlaps, or otherwise joins the ferriferous Middle Silurian as it does the C strata farther down the river.

Division (4.)

Iron Ore No. 2.

This ore corresponds very closely in character and age, with the *red ore* of Nictaux, both are fossiliferous and siliceous. In the ore under examination, *Athyris* is found, which is elsewhere only found in A strata. Its geological horizon has therefore been indicated on the map as Middle Silurian. Mr. Gilpin's explorations seem to confirm this view, as he found its extension at Ross's. Its course is therefore approximately in the strata, outcropping in Squire Campbell's marsh, in which I found a pygidium of Dalmanites of B″ Arisaig and other fossils (Crinoidea). The extension of these at Ross's also produced fossils. They were sent in my collection of fossils to the Museum of the Survey, Canada.

DIVISION (4.)

Archœan.

I found and examined these rocks outcropping in all directions along the road which leads to Blue Mountains. I have examined them to a distance of two miles. These are separate from the river by a band of Middle and Upper Silurian ? strata, which borders on the north side of the river, and comes into contact with a considerable bed of Lower Carboniferous Limestone.

The archæan rocks are felsites. In some places they have appearance of copper and micaceous iron ore. An outcrop of these appears at McPhee's giving the series a width of 2.5 miles. This may be the west side of the *archœan* of the Keppoch and Ohio, Antigonish County. I have not had an opportunity of tracing a connection between the two areas of crystalline rocks.

DIVISION (5.)

Iron Ore, (No. 3.)

The rocks of this division contain the specular Iron ore at McDonald's on the south side of the river and S. of Blanchard's This ore *in situ* was first shown to me by Mr. Donald Fraser in 1861, when I collected specimens of the various ores of the district for the London Exhibition of 1862. It seemed to indicate a deposit of economic importance. subsequently in 1868 when I investigated its geology, the outcrop was obscured by an enormous pile of stones on its top, and it was with difficulty that I secured a passable specimen of the ore for our Museum collection. I examined the containing strata and found them to be dark coloured metamorphic strata. On emerging from the woods on my return to the river, crystalline rocks were observed in a field on the right. The ouctrop of these is of considerable extent. The rocks are igneous and intrusive, like other rocks of the section on the north side of the river. We had thus the *appearance* of a monoclinal, the dip being southerly and the strike east and west. The extreme metamorphism of the rocks and the general aspect gave no encouragement for the search for palæonotological evidence of age in the rocks themselves. I therefore searched for other exposures on the line of strike. I found the rocks exposed in the course of an adjoining brook. I followed these towards Springville until I came to lower carboniferous rocks, which separate the strata under examination from the strata of Iron Ore (No. 1) on the north side of the river. Afterwards I examined the strata of the division 5 of the section which I found in the river without any carboniferous intervention between north and south, and in proximity to McPhee's *archœan outcrops*. In this way the areas of pre-carboniferous rocks having Iron ore on the *one* side of the river, were connected directly with the fossiliferous and pre-carboniferous rocks on the south side. This seemed to be one important element in correlation. Proceeding westward, down the river on its south side, I found one brook with a mill-dam ; here is another exposure of the strata under examination. Still further at Pleasant Valley another brook occurs having a mill-dam, and an exposure of the same strata. In addition I observed strata of lighter colour and greater compactness, I readily recognized a lithological feature of frequent occurrence at mill seats on Sutherland's river and its branches, where palæontology is available for the solution of difficulties. There I had to refer ths corresponding strata to A and B B', middle silurian. If lithological evidence is worth anything in correlation, it surely is of some weight in the same district even at the distance of 9 or 10 miles.

The next exposure is in the brook east of the *situs* of *Iron ore (No. 3)*, McDonald's brook. Here we have the best exposure of the strata. Along this brook I examined the strata to a considerable distance southward in search of a continuation of the Iron ore without success. Returning I reached an old mill-dam having strata of the same lithological character as the preceding, indications of A, B and B', middle silurian. Proceeding still along the bed of the brook, I found, after a considerable interval of obscurity, compact strata, having a southerly dip. These strata are hard and jointed *with films of micaceous oxide of iron in the joints*. Succeeding these at the bridge which crosses the road running up the south side of the river, I found black slates having obscure fossils, but which I have little doubt are of

Clinton age, farther on where the brook enters the river is a green marble of lower carboniferous age, and on the north side of the river opposite, in close connection with an igneous dyke is the continuation of the Blanchard strata, middle silurian, having lower carboniferous limestone in contact, I have no doubt whatever that there is a connection of the strata of the north and south areas of fossiliferous rocks under the bed of the river. The extension of the igneous rocks observed on the road to the Iron ore, No 3, would occupy the obscure interval in the brook between the two sets of strata forming a *complete anticlinal* instead of the apparent monoclinal.

All this seems sufficient to determine the approximate age of the strata containing Iron Ore, No. 3. This is consequently indicated on the map as middle silurian, which may be called the "upper series of the Cobequids." Geologists have had to call in the aid of the iron divisions of section No. 2 of our map, and to regard the former as devonian, upper or middle silurian, according to the views entertained regarding the age of the latter.

PALÆONTOLOGY OF THE REGION MAPPED.

The sign ff is of frequent occurrence on the map, in A, B, B′ C, D of the "Upper Arisaig series" having fossils, that belong

1st to the Middle Silurian period.

2nd to the Upper Silurian period.

3rd We have ff occurring in limestones of the Lower Carboniferous period.

4th In the south and north side of the coal measure polygon.

I shall briefly collate and examine the Middle and Upper Silurian Faunas ; and then examine the fauna of the Carboniferous period.

Regarding the Silurian series of the Springville division of section No. 2 as representative of the Typical series. I shall group the scattered fauna around its members. Our course will thus be direct from the lower into the middle carboniferous age.

FOSSILS OF A. FROM THE PICTOU AND ANTIGONISH COUNTY LINE AND DIVISIONS OF SECTION 1.

Nos. 1, 2, 3 and Sutherland's river.

Coelenterata.

Petraia forresteri.

Petraia, sp.

Annuloida.

Crinoidea.

Annulosa.

Cornulites.

Cornulites, trumpet shaped, Salter M. S.

Trilobita.

Calymene, sp.

Molluscoida.

Brachiopoda.

Strophomena corrugata.

Orthis, *species.*

Athyris, species.

Spirifer, like striatus.

Spirifer, sp.

Rhynchonella, sp.

Lingulæ.

Mollusca.

Gasteropoda.

Cyclonema.

FOSSILS B.

Section No. 1. Division No. 1 & 3.

Lingulæ of several species chiefly in nodules.

FOSSILS B'.

Section No. 2. Div. No. A, Springville and e Blanchard.

Sect. No. 1. Division No. 3, 6.

Coelenterata.

Graptolithus.

Graptolithus clintonensis, (priodon).

Crinoidea.

Cornulites.

Tentaculites.

Crustacea.
Beyrichia.
Trilobites.
Homalonotus Siluriæ Principis.
Dalmanites, several species.
Molluscoida.
Brachiopoda.
Strophomena depressa abundant.
Leptæna, sp.
Orthis elegantula, abundant.
Leptocœlia intermedia, abundant.
Spirifer, sp.
Lingulæ, species large.
Lingulæ, sp. small.
Discina, sp. large.
do. sp. intermediate.
do. sp. small.
Mollusca.
Cephalopoda.
Orthoceras, small.
Conularia.
Incertae cedis.

FAUNA OF C. SPRINGVILLE.

Mollusca.
Cephalopoda.
Orthoceras *large.*
Orthoceras, sp.
Orthoceras, sp.
Molluscoida.
Brachiopoda.
Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Rhynchonella saffordi, abundant.
Rhynchonella wilsoni.
Rhynchonella, sp. abundant.

Rhynchonella, sp.
Meristella didyma, abundant.
Atypa reticularis, coarse.
Spirifer crispus ?
Crania, sp.
Crustacea.
Trilobita.
Calymene blumenbachi.
Homalonotus Salteri.
Sutherland's river, in boulders,
Homalonotus Salteri.
Crinoidea.
Cornulites, large species.

Coelenterata.

Favosites fibrosa.
Stenopora.

Mollusca.

Cephalopoda.
Ascoceras.
Ormoceras. sp.
Orthoceras, sp.
Heteropoda.
Bellerophon, trilobatus.
Gasteropoda.
Holopoea.
Pleurotomaria.
Acroculia haliotis.
Lamellibranchiata.
Clidophori.
Avicula honeymani.
Modiolopsis.
Brachiopoda.
Spirifer subsulatus.
Chonetus, nova scotica.
Crania acadiensis.
Rhynchonella, various.
Discina, sp. ?

Crustacea.

Calymene blumenbachii.
Homalonotus dawsoni.
Dalmania logani.
Phacops stokesii ?
Proetus stokesii ?
Entomostraca.
Beyrichia.
Crinoidea.
Cornulites flexuosus.
Tentaculites.

The greater part of the organisms of D Springville are identical with those of D Arisaig. Still only a very small proportion of the species in the type have yet been found here. The same may be said of C, the other Upper Silurian member of the " Upper Arisaig series." When I make notes on my new map of Antigonish County this will be made manifest. It is evident however, even from the Springville series, that the fauna of Nova Scotia silurian had in C and D attained their maximum development especially in cephalopoda, pteropoda, heteropoda, gasteropoda, lamellibranchiata, brachiopoda of certain genera, trilobites and crinoids. The exceptions are as follows, viz : *Brachiopoda, orthis* athyris, spirifer, these have their beginning and climax in A, lingulæ in A and B', are rare in B' and very rare in C and D. The trilobite, *dalmanites*, is characteristic of B', *Calymene* is in A, C and D. The graptolithus expires in B'. The pteropod, conularia is peculiar to B'. Petraia have their beginning, climax and end in A.

Marine vertebrates do not appear; all are invertebrates. The cephalopoda are of the highest order, and at the same time carnivora of the period.

CARBONIFEROUS (f f.)

The fauna of the Lower carboniferous limestones succeed the Upper Silurian, in the County of Pictou and elsewhere in Nova Scotia as far as is known. This makes a large break in the succession of life. To fill up the gap the Devonian or Old Red Sandstone is required, with its fishes, crustacea, mollusca, &c.

The Carboniferous formation may be seen from the map to come into contact again and again with every member of the Upper Arisaig series, and even with the intrusive rocks that give strike and dip. It is found overlying these strata and intrusive rocks, and overlapping them *a latere* and *a tergo*. The Carboniferous strata in these positions are respectively conglomerates, sandstones, claystones and limestones. These have been formed simultaneously by mechanical and organic agencies, in various conditions of formation. We then have alternations of conditions, and sandstones and claystones are made to succeed limestones, and limestone to succeed sandstone and clays.

The oldest limestone at Springville is that which is in contact with the strata of C in Holmes' Brook and River. This is as far as seen non-fossiliferous; the next is that of McLean's quarry, and Lime brook. Sandstone strata intervene between this and D strata; this is fossiliferous, the fossils are corals of the genus *Lithostrotion*. At Grant's factory on the river are limestones with clayey strata; these are next in order; they have a richer fauna. Others on the river farther down and on the West branch are also fossiliferous. In the last the *pteropod*, *conularia* is found. This *genus* has already been recognized in B' Clinton of French river.

The collated fauna of the Springville limestones, are:

Localities.	
	Cœlenterata.
	Actinozoa.
Lime brook.	Lithostrotion pictoense.
Factory, E. River.	*Crinoidea.*
	Molluscoida.
	Producta cora.
	do. martini.
Black Teeth.	Spirifer, sp.
	Lamellibranchiata.
Factory.	Nucula?
	Gasteropoda.
	Genus?
	Heteropoda.
	Bellerophon decussatus.

Pteropoda.
Conularia.
W. B., E. River. *Cephalopoda.*
Orthoceras.
Pisces.
Cochliodus sp. Salter.

In my London Exhibition collection, Mr. Salter recognized two teeth of Cochliodas. I was puzzled to know what they were. He at the same time detected specimens of *Bellerophon decussatus.* I believe this is the first recognition of Fishes of so early date in Nova Scotia, and the first identification of *Bellerophon* in the Lower Carboniferous Limestone.

The Silurian Fauna have totally disappeared. As far as Nova Scotia is concerned, this is no great marvel, when we consider the character of the agencies that were at work during the lapse of the Devonian Period, and their stupendous operations. Thus and then Nova Scotia became largely subærial, had its form well defined, and its mountain systems established. Its coasts presented to the seas of the Lower Carboniferous period rock arrangements to a large extent corresponding with those now existing. Hence we have the carboniferous rocks directly on Archæan, Cambrian and Silurian systems, just as the marine accumulations of shingle, sand, clay, dead shells, and their debris now rest, or are in process of formation. We should take this into account, as explanatory of rock arrangements which are readily by some referred to fault occurrence. Faults there are of course, and enough of them, without an unnecessary multiplying of their number.

The conditions of the Carboniferous Period were greatly different from those of the Periods preceding, the character of life differed in accordance. The preceding were invertebrate, now it is vertebrate, Cephalopoda are rare, reptiles appear, fishes became associated with such as do occur, to regulate the number of the mollusca that now begin to exist, increase and multiply.

The Cochliodus of Springville is akin to the Port Jackson Shark, which is also a cochliodont. The Cochliodus is palatal forming a mouth pavement adapted to the grinding of molluscoida or molluscan shells.. The Cochliodus of East River does not seem to have been a large species; the teeth are not over a half of an inch in size. Our Cochliodus seems to have been an approximate cotemporary of the *Gyracanthus magnificus* of Cape Breton. A formidable and predaceous race of fishes, that pervaded the Nova Scotia seas of the Lower Carboniferous Period. Whence they came we are unable to discover. The Ichthyodorulite of Cape Breton in the Provincial Museum is regarded as unique; its length is about 22 inches, it is stout in proportion.

MIDDLE CARBONIFEROUS.

The last fauna is found in the coal formation polygon.

The localities are:

1. Turnbull's mine, McLellan's Brook.
2. Deacon McKenzie mine, New Glasgow.
3. Crown Pottery mine, New Glasgow,

At 1 and 2 I found, a number of years ago, a number of teeth of Diplodus. They are so-called from their form which is double, one lanceolate is upright the other is recurved, both are crenulated. The root has a heart-shaped prominence on its front. They belong to fishes of the shark family (Hybodont).

The localities where I found them are situate on the south and north sides of the area; from No. 3 mine I received about the same time from a miner the cast of a tooth of large size, with its owner a Holoptychius.

The teeth of Diplodus are of various sizes, showing a graduation as in the mouth of the shark. Associated with these, at MacKay mine were large and small ganoid scales and beautifully striated spines. The late Professor John Phillip of Oxford, seeing these specimens in my London Exhibition collection of 1862, remarked upon the coincidence between the Nova Scotian and British *faunas* in both having *diplodus*. He also observed that the N. S. teeth were much larger than the British. I would refer to another coincidence; the late Professor How of Windsor N. S. had just discovered a trilobite in the Lower Carboniferous limestones at Kennetcook, N. S. and forwarded me a specimen for identification. I showed it to Profèssor Phillips as his *namesake* (Phillipsia Howi; Billings). He also remarked upon the coincidence of the N. S. Carboniferous faunas with that of the mountain limestones of G. B.

We have thus examined the *marine fauna* of the formations of Pictou county, and found an interesting and beautiful succession of life, with only one serious break, from the Mayhill Sandstone, intermediate Silurian —of Salter, to the Middle Carboniferous—Coal measures, i. e.

Beginning with Upper Arisaig A. Mayhill Sandstone, or the possible equivalent of the Medina Sandstone, U. S., we have proceeded upwards through B Arisaig, where equivalent (British or American) is doubtful; then B' Arisaig, (which is considered by Hall as of Clinton Age, U. S.) next we have passed through the C. Arisaig Aymestry Limestone, (according to Salter) Upper Silurian; then the Upper Ludlow (Salter) or the Lower Helderberg and "Upper Arisaig" of Acadian Geology. We have bridged the Devonian Gap succeeding, and passed through the Lower Carboniferous into the Middle.

APPENDIX.

Nova Scotian Archæology.

Ancient Pottery.

At a meeting of the Institute December 8th, 1879, attention was directed to specimens of supposed ancient pottery, belonging to the Provincial Museum.

Dr. J. B. Gilpin at my request brought the subject before the Institute.

He agreed with me in regarding the specimens referred to as of pottery of a rude and *very ancient character.*

The first specimen of our collection, when brought to the Museum was in fragments. When restored, its singular character and construction rendered it interesting and perplexing. The bottom is a piece of quartzite, flat and subcircular. This is the basis on which the rest is formed. The other material is a sort of clay. The whole is symmetrical and saucer-shaped. The interior is banded concentric. The outside is plain but not smooth. There are now 27 specimens in the Museum, all with one exception—-a small one—-have stone bottoms. The stones are quartzite and argillites. Their several shapes generally conform to the stones selected for the bases. Their structure is uniform. They are altogether different from specimens of ancient pottery which have been found by Judge DesBrisay in Lunenburg County, and the Rev. Dr. Patterson in Pictou County, associated with stone implements, and have every appearance of greater antiquity.

Mr. J. T. Bulmer, the Librarian of the Legislative and Historical Library, on a recent visit to the Public Museums of the United States, after a search for corresponding pottery, found 3 specimens in the Museum of the Smithsonian Institution at Washington. These are believed to be productions of the Esquimaux.

Our *large find* in Nova Scotia, of which our 27 specimens is only considered to be a representation, thus tends strongly to confirm the opinion of archæologists, such as Mr. Robert Morrow, who has long maintained that the Esquimaux inhabited Nova Scotia in the 10th or 11th century.

D. HONEYMAN,

Curator of the Provincial Museum.

Halifax, Oct. 14, 1880.

BRIDGEWATER Decr. 6, 1879.

DEAR SIR.

I received by to-night's mail your card asking for a few notes on the finding of pottery, of which I sent you specimens.

In July 1877, I heard that Indians had found pieces of pottery by the "La Have," not far from this Village, where people of their race had an encampment in early times. I went to the place with one Venall, who told me that having found an arrow head near the surface, he, and other Indians had removed the ground and discovered pottery. We searched and found arrow heads and pottery, nearly all at a depth of two feet and more. One of the pieces I retained, has a round foot, as if originally part of the bottom of a pan or vessel. Another has a round hole, through which a string may have passed for carrying or hanging up the vessel. The pieces are of varying thickness and differ in the markings or designs. In some the latter appear as if made with a finger nail, in others with a stick. The marks on the upper edge, or what was the top of the vessel, are in some as if made with a round-edge stick, while others have marks like tally notches and close together.

M. D. DESBRISAY.

Rev. Dr. Honeyman.

APPENDIX TO NOTES ON THE BONES OF S. SALAR.

Plate 1.—Skeleton of Salmon from Labrador, showing left side. Length of Fish 35½ inches from end of snout, when the jaws were closed, to the centre of the caudal fin. The shoulder girdle and pectoral fin, together with the ventral fin, saddle bone, and

part of the 9th, 10th and 11th dorsal short caudal fin-rays removed.

Plate 2.—Skeleton of young S. Salar, left side, hatched at the Breeding Establishment, Bedford, near Halifax. Length of fish from end of snout to the center of the caudal fin $21\frac{9}{16}$ inches Right shoulder-girdle and pectoral fin remaining, ventral fins removed. A marked fish, part of the three first dorsal fin-rays having been cut off. Muscular fibres of the anterior attachment of the anal fin to the general structure remaining.

Plate 3. page 162.—Interspinous bones. The third interspinous bone was broken off in handling, and, unfortunately lost.

Plate 4. pages 162, 163, 172 to 174.—Dorsal fin and interspinous fin-bones.

Plate 5. pages 166 to 168, 176 to 178.—Anal fin and interspinous fin-bones.

Plate 6. pages 163, 164, 169 to 171, 174 to 176.—Showing caudal fin, saddle bone, hypural bones, bone with cup-shaped dorsal extremity. The saddle bone is removed to show the three (I find this to be the number in another fish from Labrador) representative rays, and is shown in this plate above the place it occupies in the fish.

Plate 7, pages 179 to 183.—Left side, upper, or dorsal aspect.

Fig. 1.—Pelvic bone, with part of right pelvic bone.

Fig. 2.—Ventral Fin.

Fig. 5.—Ventral appendage, with ligaments to left.

Fig. 4.—Ventral fins from young Salmon,—lower or ventral aspect.

Fig.3.—Ventral fins Codfish—upper or dorsal aspect.

Plate 8, pages 183 to 187.—Left shoulder girdle, outer side.

Fig. 1.—Supra-clavicle.

Fig. 2.—Inter-clavicle.

Fig. 3.—Clavicle.

Fig. 4.—Pectoral fin.

Fig. 5.—Urohyal bone. In the plate this bone is rather close to the clavicle, owing to the shrinking of the integument.

Plate 9, pages 183 to 187.—Left shoulder girdle, inner side, numbered as plate 8.

Plate 10, pages 183, 184.

Fig. 1.—Bones from Codfish, (outer side) corresponding to figures 1 and 2, plates 8 and 9.

Fig. 2.—Remainder of shoulder girdle, Codfish —outer side—lower part of accessory bone, page 185, showing to the left of "2."

Fig. 3.—Codfish—Pectoral fin.

Fig. 4.—From a Salmon, left side—same fish as plate 11.

a. Shows where spinal chord (myelon) divides.

b. The notochord where it passes out between the Y shaped bones.

c. Branch of spinal chord (myelon) lying upon the notochord.

d. End of the notochord.

e. Bone,—one of a pair between which the notochord passes, and by which it is protected—the anterior end supported on a pin, the posterior end is attached by fascia to the notochord. This pair of bones are of curved, irregular shape.

Below *e* is the short, irregularly shaped bone (also one of a pair) mentioned on page 164, the posterior end (right hand in plate) is attached by fascia to the anterior end of *e* ; when these bones are in their proper position, they protect each side of the notochord, nearly to its extremity.

f. The nervous corpuscle.

In the centre of fiig. 4, the pulsating ? sack is shown : the outer surface being turned upwards, and marked by a wire loop.

Plate 11.—Shows the right side of the caudal fin of a Salmon The dorsal spinous rays are removed to show the spinal chord (myelon). One hypural bone, and part of the central caudal rays removed to expose the nervous corpuscle and part of cartilaginous rim (page 169). One long and two short fin-rays laid transversely, to show notochord.—*See end of this Appendix.*

Plate 12, page 179 to 183.—Left side.

Fig. 1.—Left pelvic bone, with part of right ; lower or ventral aspect.

Fig. 2.—Left ventral fin, ventral appendage and ligaments.

Fig. 3.—Ventral fins, Codfish ; lower or ventral aspect.

Fig. 4.—Ventral fins from young Salmon—upper or dorsal aspect.

Fig. 5.—Left of *5* is the small or superior Y shaped bone. Right of *5* is the larger or inferior Y shaped bone.

Fig. 6.—Left of *6* is the short bone (one of a pair) page 164. Right of *6* is the bone *e*, plate 10, page 175.—[Figs. 5 and 6 are from same fish as plate 11.]

In order to make plate 11 more clear, I have to add.

The spinal chord (myelon) passes upon the dorsal aspect of the centra, covered by a very strong sheath, which lies between the ventral extremities of the dorsal spinous rays until it reaches the end of the vertebræ, it there divides into two principal filaments which are inclosed in a wire at the anterior extremity of the upper or small Y shaped bone. One of these filaments lies upon the notochord, following it to its extremity, where it becomes minutely divided and lost in the general structure. The second or posterior dorsal wire, incloses the notochordal branch; the other I have not attempted to follow.

The notochord passes from the posterior edge of the spongy centrum (page 170) between the forks of two Y shaped bones. lying upon the upper edge of the superior and shorter one, and extends following the curve of the dorsal long fin ray at its superior edge, being overlapped by the longest of the short fin rays (in this specimen 2 inches in length) next to the long fin ray a distance of $1\frac{1}{16}$ inches. The centre of the notochord being exactly half an inch from the dorsal edge of the caudal fin, where in plate 11 it is marked by a wire. The notochord where it issues from the forks of the superior Y shaped bone, in this specimen is nearly $\frac{1}{8}$ of an inch in diameter, decreasing a little in size until near its extremity, where it is slightly enlarged and has a somewhat blunt rounded termination; it is jointed in structure or rather shows the divisions which in the body of the fish form the centra.

The wire loop nearly in a line with the centre of the spinal column, plate 11, includes the nervous corpuscle (page 170,) which receives filaments from a ganglion by a branch from the spinal chord.

On the left side of the tail, plate 10, figure 4, are shown the orifices of the pulsating? sack (page 170); the other part of the sack being turned up and marked by a wire. This sack is supplied by the vessel which passes through the orifices of the cup-shaped bone mentioned on page 169.

Figure 4, plate 10, plate 11 as well as figures 5 and 6, plate 12 are taken from one fish, but not the fish from which my notes have been made and represented in the other plates. Between the bones protecting the notochord in these specimens, I find the following difference: in those of plate 1 the anterior bone (page 194) did not touch the posterior bone (page 175) but was separate some distance from it, the space between them being occupied by fascia; and the posterior bone was much shorter in proportion and much more strongly curved than that of the fish represented in plate 11.

The Artotypes illustrating this paper, are the work of Mr. W. D. O'Donnell, to whom the writer is much indebted for the care which he has bestowed upon them.*

Dr. Sommers presented a specimen of Trillium sessile, collected by Miss Godfrey, of Clementsport, Digby County; he believed it was the first recorded instance of finding of the species in our Province. Trillium cerectum, T. erythrocarpum grow abundantly in many localities. T. cernuum not so frequent, and now Miss Godfrey has the honor of adding a fourth to the species of Trillium growing with us.

*In this reprint it has been considered unnecessary to reproduce the Artotypes referred to.

Clark T Rogerson Oct 1976

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. V. 1881-2. PART IV.

CONTENTS.

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FOR

1879, 1880, 1881 1882

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1882.

INDEX TO VOLUME V.

TRANSACTIONS.

GEOLOGY AND MINERALOGY.

ZOOLOGY.

BOTANY.

METEOROLOGY.

MISCELLANEOUS.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 4.

Provincial Museum, Oct. 12, 1881.

ANNIVERSARY MEETING.

JOHN SOMERS, M. D., *President in the Chair.*

The following were elected Officers :—

COUNCIL.

President—JOHN SOMERS, M. D., F. R. M. S.

Vice-Presidents—ROBERT MORROW, Esq., AUGUSTUS ALLISON, Esq.

Treasurer—W. C. SILVER.

Secretaries—REV. D. HONEYMAN, D.C.L.,F.S.A.,F.R.S.C., and ALEX. MCKAY.

Council—J. BERNARD GILPIN, M. D., M. R. C. S. L., WM. GOSSIP, Hon. L. G. POWER, J. M. JONES, F. L. S., W. S. STIRLING, MARTIN MURPHY, C. E., J. R. DEWOLFE. M.D., L. R.C. S. E., EDWIN GILPIN, M. A., F. G. S., F. R. S. C.

ORDINARY MEETING, Provincial Museum, Nov. 14, 1881.

The PRESIDENT *in the Chair.*

Dr. HONEYMAN read a Paper "on the Superficial Geology of Halifax City and County, &c." The Paper was illustrated by a map.

ORDINARY MEETING, Stairs' Building, Dec. 12, 1881.

The PRESIDENT *in the Chair.*

It was announced by the Secretary that the Council had elected Mr. ALFRED A HARE as member, and Mr. F. H. GISBORNE an Associate member.

Dr. SOMERS read a Paper " On Fungi of Nova Scotia."—Dried specimens of the various species described were exhibited and examined.

ORDINARY MEETING, Provincial Museum, Jan. 9, 1882.

The PRESIDENT *in the Chair.*

It was announced that Mr. J. D. BURBIDGE had been elected a member by the Council.

Dr. HONEYMAN read a Paper "Geological Notes—Metalliferous Sands." He also read " Geological Notes"—By Simon D. McDonald, F. G. S., on Cape Rosier, and Sable Island.

Dr. SOMERS, exhibited the Heart of a Moose, and explained its Anatomy.

ORDINARY MEETING, Provincial Museum, Feb. 13, 1882.
The PRESIDENT *in the Chair.*

Mr. ROBERT MORROW, V. P., read a paper "On the Osteology of the *Lophius Piscatorius.*" The Paper was illustrated by beautifully prepared skeletons ofthe *Lophius*, and of a Codfish head, and by duplicate sints of bones.

ORDINARY MEETING, Provincial Museum, March 13, 1882.
The PRESIDENT *in the Chair.*

Mr. WM. B. MCKENZIE was reported as having been elected an Associate member by the Council.

MARTIN MURPHY, C. E., read a paper "On the Teredo navalis, and the means adopted in other countries for preventing its attacks on submerged timber." The Paper was illustrated by a large collection of specimens.

ORDINARY MEETING, Provincial Museum, April 10, 1882.
The PRESIDENT *in the Chair.*

The Secretary intimated that the Council had elected as members E. W. Plunkett, C. E., Wm. Gossip, C. E., E. H. Keating, C. E., W. Harrington, M. D.

Dr. GILPIN read a Paper "On the Shore Birds of Nova Scotia." The paper was illustrated by specimens from the Provincial Museum collections, and drawings by the author.

ORDINARY MEETING, May 8, 1882.
The PRESIDENT *in the Chair.*

The following were proposed as members : — Mr. John Douglas, and Mr. John James Fox.

EDWIN GILPIN, F. G. S., *Inspector of Mines*, read a Paper " On the Cumberland Coal Field." The paper was illustrated by a sketch map.

ROBT. MORROW, V. P., read the second part of his paper " On the Osteolgy of the Lophius Piscatorius."

The President read a communication from the Rev. E. BALL, Corresponding member, describing a Fern which was considered new to Nova Scotia. The President concluded with remarks upon the Society's Proceedings.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11—Akins, T. B., D. C. L.
69. Feb. 15—Allison, Augustus, *Vice-President, Meteorologist*, Halifax.
77. Dec. 19—Bayne, Herbert E., PH. D., *Professor of Chemistry, Royal Military College*, Kingston.
64. April 3—Bell, Joseph, *High Sheriff*, Halifax.
" Nov. 7—Brown, C. E., Halifax.
78. Nov. 11—Cockburn, Colonel, R. A.
67. Sep. 10—Cogswell, A. C., D. D. S., Halifax.
72. April 12—Costley, John, *Deputy Provincial Secretary*, Halifax.
73. Jan. 11—Dewar, Andrew, *Architect*.
63. Oct. 26—DeWolfe, Jas. R., M. D., L. R. C. S. E.
73. April 11—Gilpin, Edwin, F. G. S., F. R. S. C., *Government Inspector of Mines*, Halifax.
60. Jan. 5—Gilpin, J. Bernard, M. D., M. R. C. S. L., Halifax.
63. Feb. 5—Gossip, William, Halifax.
82. April 10—Gossip, Wm., Junr., C. E., Halifax.
81. Dec. 12—Hare, Alfred, D. C. L., Bedford.
82. April 10—Harrington, Wm., M. D., Halifax.
63. June 17—Hill, Hon. P. C., D. C. L., *Barrister-at-Law*, Halifax.
66. Dec. 3—Honeyman, Rev. D., D. C. L., F. S. A., F. R. S. C., *Secretary, Curator Provincial Museum, &c.*, Halifax.
74. Dec. 10—Jack, Peter, *Cashier People's Bank*, Halifax.
79. Jan. 11—James, Alex., *Judge of Supreme Court*, Halifax.
63. Jan. 5—Jones, J. M., F. L. S., F. R. S. C., Halifax.
82. April 10—Keating, E. H., C. E., *City Engineer*, Halifax.
64. March 7—Lawson, George, PH. D., LL. D., F. C. I., F. R. S. C., *Professor of Chemistry and Mineralogy, Dalhousie College*.
81. Mrch 14—Macdonald, Simon D., F. G. S., Halifax.
75. Jan. 11—Mellish, John T., A. M., Halifax.
72. Feb. 5—McKay, Alexander, *Secretary, High School*, Halifax.
77. Jan. 13—Morrow, Geoffrey, Halifax.
72. Feb. 13—Morrow, Robert, *Vice-President*, Halifax.
70. Jan. 10—Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 29—Nova Scotia, the Rt. Rev. Hibbert Binney, *Lord Bishop of*
82. April 10—Plunkett, E. W., C. E., Halifax.
79. Nov. 11—Poole, H. S., ASSOC. R. S. M., F. G. S., *Sup't. Acadia Mines*, Pictou.
76. Jan. 20—Power, Hon. L. G., *Senator*.

71. Nov. 19—Reid, A. P., M. D., *Sup't. Prov. Asylum for Insane*, Dartmouth.
65. Jan. 8—Rutherford, John, M. E., *Sup't. of Albion Mines*, Pictou.
64. May 7—Silver, W. C., *Treasurer*, Halifax.
75. Jan. 11—Somers, John, M. D., F. R. M. S., *President, Professor of Physiology and Zoology, Halifax Medical College.*
79. Feb. 10—Twining, Chas. F., C. E., Halifax.
66. Mar. 18—Young, Hon. Sir Wm., KNT., *late Chief Justice of Nova Scotia.*
77. Jan. 13—MacGregor, J. G., D. SC., F. R. S. E., F. R. S. C., *Prof. of Physics, Dalhousie College*, Halifax.

ASSOCIATE MEMBERS.

63. Oct. 6—Ambrose, Rev. John, A. M., *Rector of Digby.*
77. May 14—Burwash, Rev. J., A. M.
81. Dec. 12—Gisborne, F. N., Ottawa.
78. Feb. 11—Louis, Henry, Assoc. R. S. M., London.
71. Jan. 11—McKay, A. H., B. A., B. SC., *Principal of Pictou Academy.*
75. Nov. 9—Kennedy, Prof., Wolfville.
61. Dec. 8—Morton, Rev. John, *Missionary of the Presbyterian Church of Canada*, Trinidad.
76. Mar. 12—Patterson, Rev. George, D. D., New Glasgow.
81. Mar. 14—Stearns, T. G., (of New York), Middleton, N. S.
80. May 10—Walker, Jas., M. D., St. John, N. B.

CORRESPONDING MEMBERS.

71. Nov. 29—Ball, Rev. E., Maccan.
68. Nov. 25—Bethune, Rev. J. S., Ontario.
70. Oct. 17—Harvey, Rev. Moses, St. John's, Newfoundland.
71. Oct. 12—Marcou, Jules, Cambridge, Mass, U. S.
80. June 10—McClintock, Sir Leopold, KNT., F. R. S., &c., *Vice-Admiral.*
77. May 14—Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

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

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I.—Nova Scotia Geology (Superficial.) *Continued from Transactions 1875–6.* By Rev. D. Honeyman, D. C. L., F. S. A., F. R. S. C., *Curator of the Provincial Museum.*

(Read Nov. 1881.)

Part I. — Halifax County.

In H. M. Dockyard, opposite the North street Station of the Intercolonial Railway, is an elevation known as "Observatory Hill." The removal of a considerable part of this during the past summer in filling up an extensive and deep pond, afforded an admirable opportunity of examining its interior. Its proximity to my residence enabled me to note the progress of operations. The superintendent, Mr. Nolan, kindly took note of every massive boulder exposed, observing its position and size. "*Rudis indigestaque*" is its general description; structure, it had none. It was just an unloaded heap of rubbish. Its chief materials were coarse sand and clay. Through this masses of quartzite were scattered from top to bottom. The weight of one was estimated by Mr. Nolan at 13 tons. I was present at one fall in which there were three enormous boulders. One of them fell upon the car-track; nine men were required to remove it. Among the other boulders were syenites, gneisses, granites, diorites, jaspers, porphyries and diorite-amygdaloids from the Cobequid Mountains, and dolerite-amygdaloids from Blomidon. The form of this accumulation was oblong; its base occupied an area of 18 acres; its height was about 50 feet, more than the half of it still remains.

Glaciation was observed on the side of Water street, near the Dockyard, before the I. C. R. was extended to North street. Opposite the Sugar Refinery and on the same street, striation was observed last summer. The course of this was, N. 30 W., S. 30 E., mag.; N. 48 W., S. 48 E., true. This is in the direction of Blomidon and Observatory Hill. In my first paper I pointed out another course of glaciation at Wellington Station, on the I. C. R., made by the transportation of the Cobequid Mountain contingent on its way to unite with that of Blomidon for the formation of Observatory Hill and corresponding accumulations. The direction of Wellington Station glaciation is nearly N. and S. true. The Cobequid Mountain boulders have travelled overland from 65 to 70 miles; the Blomidon 60 miles. The massive quartzite boulders have travelled between ½ a mile and 8 miles.

Fort Needham.

The elevation so-called has a constitution similar to that of Observatory Hill. This, too, has Archæan syenite boulders, as well as Triassic amygdaloid. I collected specimens of these in exposures not far from the glaciation opposite the Sugar Refinery. In passing to the west side I ascended the hill. On the top I observed quartzite boulders of dimensions not inferior to those of Observatory Hill. In the western exposures on Gottingen street I collected Archæan syenites and diorites, and Triassic amygdaloids.

On the same street, opposite the Wellington Barracks, exposed glaciation is extensive. The general direction corresponds with that of Water street, S. 48 E., N. 48 W.

Citadel Hill

furnished Archæan and Triassic boulders. On the east side there is glaciation having the same direction as the preceding. The glaciation of Point Pleasant Park is generally S. 38 E., N. 38 W.

Eastern Extension.

Accompanied by Mr. Bell, High Sheriff of Halifax, I proceeded last summer to extend my acquaintance with the geology of the eastern part of Halifax County. I now give the results of my examination of the Superficial Geology.

PART II.

Waverley Gold Mines.

Coming to Dartmouth we proceeded on the road to Waverley. A short distance from the road to Preston drift was observed having a few Archæan Syenites without Triassic amygdaloids. In my former paper I noticed the occurrence of the latter on the Preston road. No more drift was seen until we reached the Waverley Mines. In an exposure of drift at the back of the stables I had collected Triassic amygdaloids on a former examination. Here they were collected a second time—two specimens. We proceeded farther and reached what is called the Old Guysboro' Road. This road runs easterly and crosses the direction of transportation. I consequently expected interesting revelations in this route. Drift was first observed near Rutherford's Mill, about four miles along the road. In it were syenite boulders. At Sullivan's (see Map of Halifax County) glaciation was seen and examined. The rock is argillite; the course of the striation is N. S. mag. (N. 18 W., S. 18 E. true). At Goff's archæan boulders, syenite and diorites are numerous. The sinking of a well showed considerable thickness of red clay. A beautiful specimen of Triassic amygdaloid with amygdals of radiating stilbite was found about a mile beyond this, which was evidently a rare one thus far east. Cuttings and other exposures of drift continued as far as Meagher's Grant. In these I found syenitic and dioritic boulders, with other amygdaloids (dioritic, with calcite amygdals) similar to those found in Observatory Hill. In Meagher's Grant, on the road to Musquodoboit Harbour, at an outcrop of lower carboniferous limestone, I observed drift with boulders of syenite and diorite. We then lost sight of the drift, our course being over solid granite. About a mile before we reached the harbour, we left the granite and entered upon argillites. These are largely obscured by the granite transportation, which has evidently taken the place of the syenite, which seems to have been intercepted by the granite belt over which we have passed. At the Harbour, on its west side, I found a few small boulders of syenite and diorite. It required close observation to find these among the abounding granite boulders. I suppose they may have reached this point by travelling along the course of the Musquodoboit River.

Jeddore.

We observed only granite transportation until we came to Jeddore. Then road cuttings gave promise of something different; but as we intended to go as far as Clam Harbour, we left the examination of this drift until our return. Approaching our destination we observed on the road a considerable outcrop of quartzite with glaciation. At the entrance of the Clam Harbour road, a large outcrop of argillite, which is beautifully glaciated, was passed, and we came soon to our terminus.

Clam Harbour.

Looking around this locality, I observed some exposures of the familiar drift of the usual reddish colour, and found syenitic and dioritic boulders. This led me to expect other exposures on the shore. We made for Clam Bay. The impression made by the first view of this Bay will not readily be effaced. It has a sweep of about 11 miles, as far as Jeddore Head, and is washed by the broad Atlantic. It was ebb-tide, showing the greatest extent of its wide beach and white sands. On the bank was observed an exposure of red drift. In this I collected syenites, diorites, &c. From this point, the similarity of the several drift banks extending to Jeddore Head was readily recognizable. Not having an opportunity to examine these, I resolved upon doing what was next best,—upon examining carefully the exposures already referred to as occurring upon the road, regarding these, as corresponding with the lofty banks on the side of the bay. Connected with our drift bank, and partially overlying it, a marine formation is in progress, washed and heaped up by the Atlantic waves and storms. This sand is beautifully white, being chiefly formed of the siliceous and micaceous *detritus* of the transported granite.

In this formation we have—

1 Ripple marking.
2 Rill marking.
3 Worm tracks.

4 Worm burrows.
5 Bird tracks. *Tringa minuta.*
6 Imbedded egg cases of Raia. *(Pisces.)*
7 *Mollusca. Natica heros.*
8 *Moactra solidissima.*
9 *Mya arenaria.*
10 *Saxicava (?)*
Crustacea.
11 Crabs.
12 Shrimps.
13 *Echinoidea. Echinus. Echinarachnius, &c.*

We have thus the "Recent" (Cené) lying directly on Post-pliocene drift. The succession is seemingly irregular. The arrangement corresponds, however, with that occurring at the other parts of the bay, and other drift accumulations on the shore, on to Thrum Cap, at the mouth of Halifax harbour. The clays andsands of the Champlain period appear to be wanting. That either these or their equivalents are absent, we have no reason to suppose. That the Red Heads and other drift banks of the shore are the extremities of the drift transportation, I do not believe. I rather believe that it may have extended to a considerable distance, and that it has been denuded to a great extent since the Glacial period, by the ceaseless action of the Atlantic. On this supposition the Pleistocene drift *may* now underlie the Banks, and be overlaid by Champlain clays and sands, with overlying clays and sands of the present period. Returning I examined the two glacial exposures already referred to. The courses of the two are parallel, being S. 10 W., N. 10 E. mag., or N. 8 W., S. 8 E., true.

The drift cuttings on the road side at Jeddore yielded, as was expected, boulders of syenite and diorite, also a beautiful diorite amygdaloid boulder, having sub-spherical amygdals of reddish quartz (chalcedonic). Between Jeddore and Musquodoboit Harbour no drift cuttings of this kind were observed. At the latter place syenite and diorite boulders were again collected.

About a mile farther, at Petpiswick, extensive outcrops of strata were observed. These are much glaciated. The very ferruginous character of the argillites affected the compass so much that I was unable to take the course of the striation. The accompanying drift cuttings on the road side showed the usual syenite and diorite boulders. In a cutting of drift at the Chezzetcook road, I found similar boulders and a large agate.

Porter's Lake.

Between this and Chezzetcook I expected most certainly to find drift corresponding with that of Three Fathom Harbour point and Half-Island, where I found Triassic amygdaloids on my first examination. (Paper 1875-6.) I found neither amygdaloid drift nor glaciation. About a mile beyond Porter's Lake we found very distinct glaciation, and of considerable width, without any appearance of drift. The course of the former is N. E. magnetic; S. 18 E., N. 18 W., true. The transportation is granite. One immense boulder near a glaciated surface, attracted particular attention. It had interfered with the growth of a tree of considerable size. By it the trunk of the tree was indented half way. Proceeding, we arrived at Big Salmon River. At the beginning of Preston, drift was well exposed in the bed of a brook on the right side of the road. I here found a Triassic amygdaloid boulder of considerable size. The granite transportation ended before we reached Salmon River. I had thus certain evidence that this belt of granite which had not heretofore had a place in our geological maps, extended in width from Meagher's Grant to Musquodoboit Harbour, less one mile,—i.e., about 6 miles in length, from Ship Harbour, next Clam Harbour, to Lake Major, near the Waverley Gold Mines, 28 miles. We have now reached ground described in the previous Paper.

Part III.

Resuming our investigations, Mr. Bell and I proceeded directly to Meagher's Grant. From this we took the road to Little River Settlement; course N. E. Syenite boulders were observed along the road and in the settlement. From this we proceeded to Middle Musquodoboit; course N. E. Syenite boulders were observed all the way. They abound at the bridge which crosses the Musquodoboit River. From Middle Musquodoboit we proceeded to Upper Musquodoboit; course, E. Deep cuttings of drift and vast numbers of syenite boulders, large and small, were observed. Reaching the road leading to the Cariboo Gold Mine, we turned in the direction of the mine; S. On the South side of the Musquodoboit River we returned to Middle Musquodoboit, observing syenite boulders all the way through, but not in so great a number as we observed on the north side, by which we went.

From Middle Musquodoboit we went to Gay's River; course, N. W. On this road we found the drift banks very numerous. and very deep cuttings, showing abundance of syenite boulders; great and small boulders of dioritic amygdaloids were also found with amygdals of calcite. At Gay's River we advanced into Colchester County as far as the "Gay's River Gold Field." On this road syenitic boulders were also observed. Returning by the same road to Halifax County, we proceeded to Elmsdale by the old road; S. W. Drift, with syenitic boulders, was observed all the way. A short distance beyond the road to Milford, syenitic boulders were particularly noticed beside a "roche moutonnee" very singularly rutted. Here the Cobequid Mountains, the source of the syenitic boulders, were seen in the distance, without any intervening elevations.

From Elmsdale we returned to Dartmouth and Halifax city. Between Elmsdale and Waverley we missed the familiar drift, with syenitic boulders. Instead of these we had another granite transportation from the belt of granite which is seen from the Intercolonial Railway, on the east side of Fletcher's Lake, as we pass by Railway from "Windsor Junction" to the "Wellington Station." We now come to the end of the old Guysboro' road, which we have already travelled twice.

Part IV.—Colchester County

I resumed my investigation in this County, accompanied by the Hon. Samuel Creelman, Chief Commissioner of Mines of Nova Scotia. We proceeded by railway to the Brookfield Station. This station is distant from Three Fathom Harbour 43 miles; from the Cobequid mountains, 17 miles. Here syenitic boulders are found in abundance. From this we went to the Brookfield iron (hematite) deposit; thence to the lead mines of Smithfield and Pembroke, and then to the "Cross Roads" of Upper Stewiacke and "Round Bank," Mr. C.'s residence, our course being generally easterly. In all this tortuous route syenitic boulders were seen in abundance. Like Mr. Bell, Mr. Creelman had become greatly interested in my investigations, and he now regards the boulders of life-long acquaintance in a new and interesting light. The "Cross Roads" just referred to are noted on our maps. The striation of Clam Harbour extending northerly passes through this point, and cuts the Cobequid mountains in the vicinity of "Mount Thom," Pictou County, where the Archæan belt seems to terminate. I consequently expected the syenite and associate boulders to diminish in number and gradually disappear to the east of the "Cross Roads." Standing in front of Mr. C.'s residence we see Berry-hill on the south side of the Stewiacke River. On either side of it there is a depression. The Clam Bay line of transit would seem to run along the left depression, while the Jeddore would traverse the other. We went to the top of this hill (S.). On the table land are several extensive farms. The Archæan boulders which abound below seem to have almost disappeared. After a diligent search among stone cairns collected out of the cultivated fields, I found only half-a-dozen diorites. We traversed a summit road to some distance westward, toward the Jeddore line, without observing the looked for boulders. Descending northwest on the side of this depression, we came to the line of boulder passage (Jeddore line), and reached the region of abounding boulders. Afterwards I investigated the region to the N. E. of the "Cross Roads." Contrary to expectation, I found Archæan boulders in abundance, as I went along the course of the Stewiacke River, toward the Pictou and Colchester County line. In the river the abundance of boulders, both large and small, was particularly observed as well as their variety and beauty. I advanced to within two miles of the County line, and found large boulders still occurring. I left off the search for their termination at this time.

We afterward proceeded to "Riversdale station," of the Pictou railway, i. e., in a northerly direction, toward "Mount Thom." Archæan boulders were seen in abundance occurring along the road, except where the mud and mire were too deep for any stone to raise its head They were seen at the station, and on the north of Salmon River, in sufficient abundance and magnitude, and at no great distance from the mountain. We were now 47 miles N. of Clam Bay, and 3 miles S. of Mount Thom. From Riversdale we returned by railway to Halifax.

Part V.—Pictou County.

I returned to Riversdale station and thence proceeded onward. On both sides of the line of railway, Archæan boulders were observed. I stopped at West River station for the purpose of examination. Here boulders abound. Those in front of the station are occasionally of large size, most of them are syenite, one is granite, being composed of quartz, muscovite and orthoclase and resembling the granites of Halifax. It is much different from the other granites which I have found in the Cobequids, although it is unquestionably derived from rocks of the same series. I then walked along the road which leads to settlement S. E. of the station. The usual boulders were observed all the way,—1½ miles. I collected at the end of the road, syenites, diorites and dioritic amygdaloid. Further examination in this direction is deferred to another season. Returning to Halifax I stopped at Milford station for the purpose of examining the *roche moutonnee*, referred to in Part III. Starting from Milford in search of this rock, I had some difficulty in finding it, so that I travelled about thirty miles before I succeeded in my search. These wanderings, however, were of service, as they showed me Archæan boulders in all directions, and the want of triassic boulders where I expected to find them. On the *roche* in question I observed five well-defined parallel lines having a course S. to E. N. 10 W. Besides these are parallel *ruts*, having a course S. 40 E., N. 40 W. Two of these were bent and turned in a direction S. 30 E. The character of this rock, quartzite, its position 13 miles east of the Halifax meridian, north side of the band of metamorphic rocks, in sight of the Cobequid mountains, and its very distinct glaciation, led me to regard it as a very interesting object. In my paper of 1875-6, I quoted an observation from a table in " Acadian Geology," a position at the Gore having striation with a course S. 20 E. I had resolved to search for this striation. This *roche* saves me the trouble, and seems to furnish a sufficient reason, in connection with other observations, to which I shall yet refer in a future paper, for the distribution of boulders to the east of Clam Harbour line. It also gives occasion to modify certain conclusions at which I had arrived in my first *Paper*. Coming from the N. E., I searched as far as Elmsdale for boulders and minerals from the Triassic eruptive rocks, which extend as far east as Five Islands, without finding any. In my *Paper of 1875-6*, I stated that I had found specimens in the clays of Enfield. Last summer I found a specimen as I was approaching the top of Grand Lake from the Enfield station. Enfield, therefore, seems to be the limit of their distribution in this direction. The other extreme points seem to be half-a-mile beyond Gore. On the old Guysboro' road, the east end of Preston and the west point of Five Fathom Harbor. These two seem to be a sort of outliers, while extreme points of the main triassic amygdaloid transportations are Fletcher's station on the Intercolonial, Navy Island, on the east side of Bedford Basin, Dartmouth Cove and Laurencetown, at Half-Island.

GRAND LAKE.—(CENE FORMATION.)

While investigating the Pleistocene Geology around Grand Lake, I directed attention to the Lacustrine forms which I believed, in common with others, to be "Prehistoric Pottery." (Proceedings 1879-80.) I examined these *in situ*, and secured several specimens. I was therefore led to entertain some doubts in regard to their artificial formation. A chemical examination showed me that the supposed plastic portion of the article was *Hydrous iron sesquioxide*, and that the supposed pottery was " Lacustrine hematite concretions," We have therefore in Grand Lake a new formation in progress of a singular construction.

ROCKING STONE.

Roche Perché.

The Rocking Stone of Spryfield has long been regarded as an object of interest; it is situate about 11 miles north of Pennant Head, and 5 miles west of Sandwich Point, which lies between York Redoubt and Herring Cove. I had long heard of it, but had not seen it until the last Saturday of last October. I was astonished at its imposing appearance. Having reached its top by a ladder, which is placed against it for the convenience of visitors, I enjoyed a strange rock in this wonderful cradle. My conductor and companion, Simon D. Macdonald, F. G. S., seeing me seated on the top, went to the end of a lever, also placed in position, and commenced operations. The mass began to move, the motion increased and the rocking commenced, and was continued until I was satisfied. Mr. Murphy, C. E., Provincial Engineer, informed me that he had measured the boulder and calculated its weight, which is about 200 tons. It must be wonderfully set and balanced. It is placed in the forest, a beautiful little lake is on its west side. The sun setting in the west, the scene was beautiful and romantic. The boulder has a venerable look. It is coated with lichens, so that its lithological character is not at all apparent. This has led to the belief that it is not like the rocks around. My hammer soon satisfied me regarding its true character. It is a mass of coarse, porphyritic granite. Its constituent minerals are glassy-brown quartz, black mica and beautiful white orthoclase. The rock upon which it is poised is of the same character, and so are the other granite boulders in the locality. It may have travelled 9 or 10 miles, or it may not be far removed from its original position. As we walked to and from, I made observations on our way which I shall briefly describe:

HALIFAX TO DUTCH VILLAGE.

Our starting point is North Street, opposite Railway Station and H. M. Dockyard. Along North Street we proceeded westward. Beyond Agricola Street crossing is an outcrop of argillites, beautifully glaciated. The course of this striation is S. 20

E., N. 20 W., mag.; or S. 38 E., N. 38 W., true. This is 10° different from the course already observed at the Sugar Refinery opposite Wellington Barracks, and at Brunswick street, Citadel Hill. *Part* I. This striation corresponds with that of Pleasant Park, which is generally S. 20 E., mag. *Paper of 1875-6.* Coming to Leahy Villa, we find another glaciated exposure. It is 30 years since I first discovered this. The appearance is not now so striking as it was then. I had heard of Agassiz's glacial theory and glaciation before leaving Scotland. This was the first glaciation that I had seen. Since then it is very much defaced; the glaciation has largely shelled of. I would remark that the position of the argillites is vertical. It would be impossible for me to cut off either with hammer or chisel, a piece of unstriated surface, as the weather has done, or as I could do this if striated. This would seem to indicate that a thin *stratum* had been formed on the ends of the tilted argillites by the pressure of the striating agency. Here the prevailing course is S. 10 E., mag. Feeble and small *striae* diverge from this course; grooves occasionally run to 30° and return to 20°. Faults are very numerous here and elsewhere, varying from 2 to 9 inches. The course is not interrupted by these. The north side ascends and then at a considerable angle, and then it becomes level. Two granite boulders lie on this exposure; of these, the largest is 3½ x 3 x 2 feet. The extent of exposure is 300 x 150 feet. Farther on in the drain on the north side of the road, is another exposure, having a width of 30 feet, and striation course S. 20 E. There are still two others before reaching the Bridge. The striation of one has been shelled off, the other has a steep northern inclination on the surface. Coming to the North West Arm, our course was changed from W. to S. W. Here we observed great sections of drift. The boulders were granite, gneissoid and argillites, syenites and diorites and amygdaloids, dioritic and doleritic were absent. We entered on a road which I had not previously travelled. We were now among granites. Coming into line with Williams's Lake, we suddenly passed into gneissoid rock, and then into granite. I recognized an old acquaintance, and was on familiar grounds, having followed the gneissoid rocks on this side of the harbour, in all their windings and dovetailings, into the granite, and defined them on the Admiralty Charts of Halifax harbour, years ago. Here the granites are strikingly porphyritic; these are *roches moutonées*. The ruts in these indicate transportation and its direction. The deep ruts only survive; air, ice and water have so affected the material of the rock as to efface fine striation. Coming to a cross road, we turned to the right and at length reached the " Rocking Stone." Not being altogether satisfied, I returned to the N. W. Arm the succeeding Saturday and continued the westerly course beyond the bridge, going along the St. Margaret's Bay road. Rocks outcropping on the right side are gnessoid. I found one beautiful syenitic gneiss boulder on the road. This is the only one that I have seen west of H. M. Dockyard. Drift cuttings are observed without noteworthy boulders. Approaching the Halifax water works the granites which extend south to the Atlantic coast came forward to the road. They are seen in conjunction with the gnessoid rocks. At a distance of four telegraph poles beyond the four mile post, a gnessiod rock is seen on the left side of the road, scooped out, with striation on the side of the scooping. The position of the striation and the ferruginous character of the rock, made it impossible to observe the course accurately with the compass. It seemed to be about S. 20 E., N. 20 W., mag. A large granite boulder rested above. The granite here is not porphyritic as that in the vicinity of the Rocking Stone; the constituent minerals are the same. This is granite transportation No. 3. The amygdaloidal and syenitic transportation, which Mr. Hare reports on the north, seems to have been intercepted. —*Paper by Mr. Hare, Transactions, 1879–80.*

CENE.

In the lake at the Halifax water works, Mr. Keating, the City Engineer, reports the existence of an argillaceous deposit, which is largely composed of diatoms. Its thickness is about 6 feet.

(To be continued.)

ART. II.—NOVA SCOTIAN, FUNGI—J. SOMERS, M.D., F.R.M.S.

(Read Dec. 12, 1881.)

I HAVE been enabled during the past season to make the following additions to our mycological Flora; before proceeding therewith, I wish to record an expression of thanks to Professor Chas. H. Peck, of the State Museum of Natural History, Albany, N. Y., for very great kindness in diagnosticating and naming several species of which I had no description, I trust that students of Botany who are working in this branch will soon have from the pen of the professor a work which in its own department will rival the celebrated Text-book of Dr. Gray.

ORDER—AGARACINI.

1. Agaricus (Mycena) galericulatus. *Scop.* com. Sept. '81.
2. A. (Pluteus) cervinus, *Schœff*, com. Sept. '81.
3. A. (Entoloma) strictor, *P. K.*, W. P., " "
4. A. (Eccilia) carnogriseus, *Br.* " "
5. A. (Leptonia) lampropus, Fr., *in pastures.*
6. A. (Hebeloma) fastibilis, Fr., com. Sept. '81.
7. A. (Galera) Hypnorum, Fr., Oct. '82.
8. A. (Psilocybe) spadiceus, *Scoœff*, Oct. '82.
9. A. (P.) cernuus, Mull, under willow, Oct. '81.
10. Coprinus micaceus, Fr. common.
11. Cortinarius (Inoloma) lilacinus, *Peck*, Willow Park, Sept., Oct. '81.
12. Lactarius torminosis. Fr., Aug. '81.
13. L. quietus, Fr., in woods, Nov. '81.
14. L. Cyathula, Fr., Fir woods, Sept.
15. Russula depallens, Fr., under spruce.
16. Cantharellus, floccosus *Schw* under pine trees, N. W. A., Oct. '81.
17. Lenzites abietina, Fr,, on larch stump.

ORAL II.—POLIPOREI.

18. Polyporus picipes, Fr. Oct. '81.
19. P. chioneus.
20. P. albellus, *Peck,* Willow Park, Oct. '81.

Gen. Dædalea. Fr.

21. Dædalea, quercina, P., on old trunks, Oct. '81.

ORDER, HYDNEI.

Gen. Irpex. Fr.

22. Irpex tulipiferæ, *Schw.* on dead branches, Willow Park, Oct. '81.

ORDER.—AURICULARINI.

Gen. Hymenochœte. Lev.

23. Hymenochæte, tabacina. *Lev.*
Dead branches on the ground, Oct. '81.

ORDER.— CLAVARIEI.

Gen. Clavaria.

24. Clavaria, abietina. *Schum*, under spruce Fir, Sept. '81.
25. C. Pulchra. *Peck.* Beech grove, 3 mile House, Oct. '81.

Fam. Gasteromyectes.

ORDER.—MYXOGASTRES.

Gen. Æthalium.

26. Æthalium, septicum, Fr., on dead willow stumps, Sept. '81.

ORDER.—NIDULARICEI.

Gen. Crucibulum.

27. Crucibulum, vulgare. *Tul.*,
on dead twigs, on the ground, Willow Park, Oct. '81.

Fam. Ascomyectes.

ORDER.—ELEVELLACEI.

Gen. Leotia.

28. Leotia, lubrica. *Pers.*,
on the ground under Birch, 3 mile House, Sept. '81

ORDER.—SPHÆRIACEI.

Gen. Hypomyces.

29. Hypomyces, lactifluorum. *Schw.*
Parasitic, on fungi, Willow Park, Sept. '81.

Gen. Hypoxylon.

30. Hypoxylon, concentricum. Grev.,
on dead Birches 3 mile House woods, Oct. '81.

Article III.—Geological Notes. Metalliferous Sands. By the Rev. D. Honeyman, D. C. L., F. S. A., F. R. S. C.

(Read January 9, 1882)

I would direct attention to certain Metalliferous Sands, specimens of which have been added to the collections of the Provincial Museum, and to their affinities.

1.—Auriferous.

This is a specimen from Jegoggin Point. Vide Paper " On the Geology of Digby and Yarmouth Counties." Trans. 1880-81.

In this Paper I directed attention to the *Garnet sand* of Lake George, and its origin. I also noticed Jegoggin Point as a locality where rocks are largely micaceous schists, replete with garnets. These were considered to be a continuation of the Lake George rocks, from which the garnet sands were derived. When I was examining Jegoggin Point, with Mr. S. M. Ryerson, I observed great veins of quartz pervading the garnetiferous schists. Mr. R. informed me that gold had been found in them. I was therefore not at all surprised when I heard that Mr. Cowan had found gold in the sands of Lake George. The fact of the existence of a gold mine at Cranberry Point, adjoining Jegoggin Point, and in the same singular belt of rocks, in a manner prepared me for the report. So when Mr. Cowan showed me his gold washings in the Museum, I was convinced of their genuineness by seeing the garnets associated with the gold. He told me at the same time that his washings were not from Lake George. As the other alternative, I suggested Jegoggin Point. He answered that that was the place. When I examined Jegoggin Point I did not take time to examine its sand, as it was down among the rocks; but I inferred that this, too, would be found to be garnetiferous, as well as the sand at Lake George. This inference is sufficiently obvious. The existence of gold in the sand seems to confirm Mr. Ryerson's statement that gold had been found in the quartz veins. Description of specimen: The most striking part of it are numerous scales of gold; these are associated with beautiful crystals of garnet, having sharp angles; there are also grains of magnetite and silica. The magnet readily separates the magnetite. There are other black grains which may be hornblende. Hornblende is seen in the schists as well as garnets. The gold and silica may be derived from the quartz vein. Grains of magnetite may exist in the schists in the same way as it occurs in the Archæan gneisses of the Cobequid mountains. Vide Paper "*Archæan Gneisses of the Cobequids Magnetitic.*" Trans. 1880–81. The association of gold with garnets and magnetite in the auriferous "Archæo-Cambro Silurian (lower) of Nova Scotia seems to be of additional interest, as it suggests relationship with distant and foreign auriferous formations where gems and gold with magnetite are seen associated. It certainly has a tendency to correlate the "Nova Scotia Gold Fields" with the "Medicine Bow Range,' Wyoming, U. S. This is regarded as having a "strong resemblance" to "characteristic beds" of the "Huronian formation in Canada." "The rock masses which form the Medicine Bow Range have as constituents quartz, orthoclase, plagioclase, hornblende, mica, chlorite and carbonate of lime. As accessory minerals there occur garnet, epidote, magnetite, pyrite, cyanite, *gold* and calcite; under the microscope, in addition to the above, were detected, zircon, apatite and titanite." - Descriptive Geology. Medicine Bow Range. By Arnold Hague. Page 109. United States Geological Exploration of the Fortieth Parallel, Clarence King, geologist in charge. Vol. II. Page 109.

We have all the constituent minerals above enumerated as constituents of our rocks, and all the accessory minerals recognized, with the exception of cyanite, zircon and apatite. In the place of these we can substitute staurolite, andalusite, tourmaline, arsenopyrite, calchopyrite and molybdenite. As I use the term Cambrian, as it is understood by H. M. Geological Survey of Great Britain, my nomenclature, Archæo-Cambro-Silurian (lower), will be considered by some as equivalent to Archæan, applied to the Medicine Bow Range, Cambrian and Huronian being regarded as convertible terms. I would observe also that the distinction made by Mr. Hague between his Colorado and Medicine Bow "Archæan," is precisely the same as I make between our great Gold Field series of rocks, and the

Arisaig "Archæan," or the Archæan of Cape Breton, the Cobequid Mountains, &c.

2.—Magnetitic.

Through William Ross, Esq., Collector of Customs, Halifax, I have received a specimen of magnetitic sand from Cape Breton. Of 100 grains, the magnet separated 15. The remainder largely consists of garnets and amethyst (?), and possibly titanite; gold is wanting. It is possibly derived from the Archæan crystaltine rocks of Coxheath. The locality where it is found being Ball's Creek. It is said to be in considerable quantity. I have not yet *seen* any garnets in the rocks of this series, either in Nova Scotia or Cape Breton. Magnetite is found. *Paper "Archæan Gneisses of the Cobequid Magnetitic, 1880-1."*

3.—Magnetitic.

I am indebted to S. D. Macdonald, F. G. S., for the specimen which I am now to describe. It is from Cape Rosier, P. Q. Its weight is 65 grains. Of this, about 10 grains are taken up by the magnet. The remainder consists chiefly of garnets and amethystine grains. It is very like the Cape Breton specimen. Boulders were collected in the same locality. These are of granitic and syenitic gneisses. In the one garnets are seen, and in the other grains of magnetite. So that the rocks that furnished these boulders, in all probability, are the sources of the sand of our specimen. It is therefore of Archæan (Huronian) origin, like the Cape Breton magnetic sand.

4.—Magnetitic.

There is yet another specimen in the Museum collection to which I would refer. It is several years since I received it. It was brought for the purpose of getting my opinion of its value. Its mineral constituents are the same as of the three last described, but it far excels these in the proportion of magnetite. It covers the magnet very readily. I think that this was the reason why I did not receive definite information regarding its locality. If the locality is not in Newfoundland, it is in some part of the Labrador coast. There is a piece of magnetite in the specimen. It is doubtless of Archæan origin.

5.—MAGNETITIC.

There are also deposits of magnetite sands in Sable Island. Attention was devoted to these long ago. It is more than 10 years since I received specimens. The late Professor Howe included this sand in his collections at the International Exhibition of London, 1862. It corresponds with the sands of Cape Breton, Cape Rosier, and also No. 4, and is different from the auriferous-magnetic sand of Joggin Point. I never saw gold in any specimen. Prof. Howe, in his analysis, found titanium. Any specimens that I have seen are less magnetic than that of Cape Breton. Mr. Macdonald has anew directed my attention to it by presenting to the Museum a specimen of what he collected during a recent visit to the Island.

Sable Island is 95 miles south-east of Cape Canso, and may be underlaid by an extension of the rocks of either Nova Scotia or Cape Breton of any formation. There can be no doubt that its magnetic sands are of Archæan extraction, and in all probability they are *glacially* transparent, and that from the coast of Labrador, where the Archæan is like that of Cape Rosier, granite and garnetiferous and syenitic and magnetic. The Arctic current, with its ice freight, according to the Admiralty charts, passes along the south side of Sable Island bank, outside of the soundings. This may have been the agency employed in transporting the magnetic sand to Sable Island.

ART. IV. — GEOLOGICAL NOTES. BY SIMON D. MACDONALD, F.G.S.

SABLE ISLAND.

(*Read January* 9, 1882.)

HAVING carefully examined the different points in the vicinity of the main station, where gold was said to have been found, and as yet being disappointed in not finding an opening among the hummocks that I could call an average section, showing the stratification as visible on a small scale in the several indentations along the shore, I turned eastward, feeling assured from the gradual ascending character of the Island in this direction, and i s curvature to the north-east, that I should yet find among the hills sheltered from the prevalent south-west winds,a section that would reveal the internal arrangements of this remarkable formation. Nor was I disappointed, for while plodding along the landwash in company with the south side patrol, at a slight turn in the coast, we came suddenly upon a beautiful escarpment some 80 feet high and reaching inland about 500 feet.

The late southeast gales had undermined the embankment at this place causing a downfall, and thereby had produced a fresh exposure of the sand cliff.

The section of this exposure is as follows:—

1. A strata of dark ferruginous sand........ 2 feet.
2. Dark mottled Ferruginous, Siliceous and Garnetiferous sand..................50 feet.
3. Garnetiferous and Siliceous only........20 "
4. Siliceous sand, light buff colour, with few garnets............................10 "

On comparison with another exposure seen subsequently, I considered this as a typical section of the whole formation of this Island.

Here my friend, the patrol, kindly offered to take me to a place on the south side of the lake where he informed me there was an exposure of jet black sand. Thither we turned our steps when a recall from our steamer somewhat abruptly terminated our expedition in that direction. A sudden shift of wind and a fast rising sea necessitated our presence aboard, and in a few hours we were heading towards the coast in the teeth of a north-wester.

CAPE ROSIER.

From Grand Greve to the summit west of Cape Bon Ami the road tends north-eastward across the Gaspe limestones, which are here obscured by drift.

The summit is of grey calcareous shale. From this point the scenery is grand and imposing.

A few feet from the right of the road the precipice is perpendicular about 700 feet. On the left is an escarpment of upwards of 1200 feet, in many places overhanging the tide.

Along the side of the cliff the road descends at an angle of about 45°, in many places cut in the face of the rock.

This formation is grey limestone, in layers of from 6 to 8 inches in thickness, separated by bands of greenish shale, and much shattered. In many places it rises in sharp pinnacles, presenting a grand castellated appearance.

During the spring months the road is abandoned for a more circuitous route by boats around Cape Gaspe, travel being too hazardous from the continual falling of debris along the face of the mountain.

From the foot of Cape Bon Ami towards Cape Rosier the coast is low and shelving.

From the violence of south-east gales the entire distance between those Capes is covered with grey limestone shingle, except at Cape Rosier lighthouse. This magnificent structure, which is the finest in the Gulf, is built upon strata of grey limestone, with alternate bands of conglomerate resembling that of Perce Mountain.

The whole is interstratified with black and grey shales.

At the base of the light house I counted upwards of 20 veins of calcareous spar, from one to three inches in width. Some of these contain cubes of galena.

From this point north-west the character of the shingle changes to that of granitic gneiss and shales, which are probably of Archæan age.

At several places along the shore toward Griffin Cove, where it is possible to remove the shingle, there are seen deposits of black ferruginous sand.

At Mr. Whalen's, in the vicinity of Cape Rosier, I was shown a large pan of this material, taken from an embankment for inspection, on my return from Griffin Cove.

From the magnetic character of this sand, and its appearance under the glass, I believe it to be same as that of the Moisie river deposit, shown to me by Capt. LeMeasuer, at Cape Gaspe. It is probably derived from the granitic gneiss.

On the Bones of "Lophius Piscatorius,"—Angler Fish, Devil Fish, Goose Fish, &c., &c.

(*Read 13th Feb'y. and 8th May*, 1882.)

1. Beginning with the frontal bone. You will notice that in this fish it is divided by a serrated suture into two parts, each having on its outer edge a peculiar dentated margin ; looking at the two parts as one bone, its central upper surface is depressed, and at about two-thirds of the length from the anterior ends it has two so-called spines on each outer edge.

2. The prefrontals of this fish, when compared with those of the Cod, have the appearance of being reversed, the side which is down in the *Lophius* appears to be uppermost in the Cod, this is in consequence of the attachment of the palatine bone to the anterior edge of the prefrontal, so that the palatine bone, with its teeth, follows nearly the line of curvature of the premaxillary. The long arms of the prefrontals are attached to the frontals underneath their outer anterior margins, and are largely supplemented with fibro-cartilage, extending between the anterior forks of the frontals.

3. The ethmoid is absent.

4. Post-frontals—each has upon it two short spines, and on its outer edge, between the spines, two depressions, the anterior the largest, and on its under side, at about the middle of the anterior depression, the bone forms an angular ridge, above the anterior edge, and in advance of which lies the orbitosphenoid.

5. The basioccipital, at its under posterior extremity, is wide, owing to the presence of thin bony plates for its attachment to the exoccipitals, and is somewhat contracted at its anterior extremity.

6. The basisphenoid is a much broader bone than that of the Cod, and has upon its lower side two arms projecting upwards and posteriorly, the wings being attached to these arms, and reaching nearly to the anterior extremity of the presphenoid. The vomer is inserted in a cavity within the presphenoidal portion of this bone.

A. Between the parietals and the posterior extremities of the frontals, lies a bone somewhat oval in shape and depressed in its centre, it is attached to the parietals by suture, its anterior end by fibro-cartilage to the posterior extremities of the frontals, and it carries upon it the isolated ray of the first dorsal fin, together with its equivalent interspinous ray. It is a "*wormian*" bone.

7. The parietals—this fish, having no median crest, unite; near their posterior extremities they have each a small, so-called, spine, and are joined to the supraoccipital.

C. Immediately beneath the parietals, and extending from their anterior extremities, posteriorly, a little more than half their length, also supported by the exoccipitals, and extending transversely, united by a serrated suture directly under the suture of the parietals, are a pair of bones which would seem to serve in the *Lophius* the same purpose as the otoliths in the Cod fish; they are separated from the parietals in the dried skull by a delicate membrane, and on their superior surfaces are smooth and somewhat conical, having in each, on their outer margin, a deep angular depression; on their inferior surfaces they are rough and cancellated, and from the centre of their posterior margins a bar runs across each obliquely outwards to the lower margin of the depression which appears on their superior surfaces; this bar is perforated by a foramen of considerable size. I have not been able to obtain a fresh specimen of this fish in time to make a further examination of these bones.

8. The supra-occipital appears to be anomalous; it takes its rise from, and is anchylosed with, the neurapophyses of the Atlas, which together with it forms the very large foramen magnum, at the same time it forms, almost perpendicularly, a semi-circular cover to the upper posterior part of the skull, as you may see by reference to the skeleton.

9. The paroccipitals project nearly at right angles to the skull, for the peculiar attachment of the supraclavicles; looked at upon their under surfaces they are arrow-shaped, the longer blade of the arrow being on the outside, the shorter on the top of the skull.

10. The exoccipitals are very similar in shape to those in the Cod, but are each perforated by two comparatively large foramina of equal size.

11. The alisphenoids of the *Lophius* are largely supplemented with fibro-cartilage, in their attachment to the adjacent bones, and they are comparatively flat on their upper surfaces.

12. The mastoids, which are deep, short bones, together with the prefrontals, form the seat of the hyomandibulars; upon each there is a spine, and the points projecting from the outline of the skull are quite short.

13. In the *Lophius* I cannot find the squamosal.

14. The orbitosphenoids are extremely small and delicate membrane bones which lie beneath the posterior extremities of the frontals, immediately in front of the post-frontals; in their structure they are very beautiful.

16. The vomer has, in the one exhibited, at present only two teeth, one in each extremity or arm, but it may have had at one time three on each arm, most probably only two at the same time; the large skeleton before you has, as you will observe, two teeth on each arm. On its upper side, curved backward from the teeth, the vomer has a projecting bony plate forming a groove for the reception of the prefrontals, and its posterior extremity, as already stated, is inserted in the cavity of the presphenoid.

17. The inter or premaxillaries are armed on their anterior edges, to their extremities with a row of teeth; those near the median line being five or six long teeth of a character similar to those on the dentary, the remainder are small but gradually increase in size toward the extremity of the bone. On their posterior edges there is a row or rows of teeth extending about half the length of the bones, and speaking generally, decreasing in size from their superior extremities. These bones are from the enormous size of the gape, long and somewhat thin plates; from their superior extremities gradually narrowing for about half their length, their breadth then increases and they terminate inferiorly in a somewhat (posteriorly) scymeter shaped edge. The processes for their attachment to the maxillaries and nasal bones are flat, and in a line following the general line of the top of the skull, but their extremities are oblique, receding from the central line.

18. The maxillaries have upon their superior extremities somewhat lengthy depressed processes for their attachment to the intermaxillaries, so that their superior surfaces lie beneath the inferior surfaces of the processes of the intermaxillaries, and they also articulate with the vomer. That they may form their connection with the articularies they are twisted at one-third of their length from the extremities of the processes already mentioned, so that their inferior are nearly at right-angles to their superior terminations. These bones gradually increase in breadth from their superior until a short distance from their inferior extremities, when they taper to a point.

19. The *Lophius* has no suborbital ring.

20. The turbinal bones (nasal—Owen) are strong and firm, having the same structure as the premaxillaries; their anterior extremities articulating with the posterior superior extremities of the premaxillaries; at this point in the living fish they are capable of considerable lateral motion, and they are attached to the premaxillaries by flat terminations in a line perpendicular to the axis of the fish; at about one-third of their length from their anterior extremities they each assume an irregular triangular form, and gradually taper to a point; at their centres they are sustained by the prefrontals, and between them lies the peculiar spine which supports the first and second rays of the first dorsal fin.

22. The palatine bones articulate between the maxillaries and the prefrontals, close to the toothed arms of the vomer, and on these bones the teeth, of which there are four to six long, and about six short (these latter generally increasing in size as they tend towards their inferior extremities), lie nearly in a line with those on the vomer. On the superior extremity of these bones are two of the so-called spines, which, as they rise above the maxillaries, are generally enumerated in descriptions of the outside of the fish. The inferior extremities of these bones are attached to the inferior edges of the pterygoids.

23. The hyomandibulars have very broad double surfaces for their articulation with their bases, and are very much enlarged at their upper posterior edges. An examination of these bones

will show you that this is essential to the support of part of the opercular apparatus. On their interior inferior terminations there are no prominent surfaces for the articulation of the stylohyals but they rest in a groove and have thin ligamentous attachment.

24. & 25. The pterygoids and entopterygoids are represented in the *Lophius* by single bones, one on each side, which are of an irregular oval form at their posterior, assuming a subtriangular shape at their anterior extremities, and have small processes which connect them with the quadrate bones. They are very thin membrane bones, and the portion below their processes may be taken to represent the pterygoids, for to them are attached primarily the palatines. The upper portion of these bones will represent the entopterygoids.

26. The quadrates, as well as the other bones connected with them, are, for such large fishes, very delicate. The condyles, for their union with the articularies, are exceedingly small, and appear on the inner sides of the bones; rising from them are ridges, folded posteriorly, against which abut the preopercular bones: below the condyles, extending posteriorly and downwards, at a small angle, these bones present somewhat broad surfaces, having at their posterior edges sharp points or spines, which, when the fish closes its mouth, are easily seen.

27. The metapterygoids are very delicate fan-like plates, having narrow thickened edges, which, at their upper arms connect with the hyomandibulars nearly in their centres. These edges are a little wider, and have projecting processes for the attachment of the ligaments which tie them to the prefrontals.

28. The opercula are long and narrow, nearly straight, bones, which articulate with the hyomandibulars just below their junction with the mastoids and prefrontals, they are almost flat on their inner, and have ridges on their outer surfaces; beginning at the centre of their superior and terminating at their anterior edges on their inferior extremities, these ridges support the subopercula; at their superior extremities, they throw out posteriorly each a long slender fin-like ray.

30. The preopercula are small and narrow curved bones, angular at their posterior edges, having ridges upon them which show

on their outer surfaces, and which support the posterior arms of the hyomandibulars; on their inner surfaces they are irregularly flattened, and terminate in an acute angle, abutting for more than half their length against the ridges which rise from the condyles of the quadrates.

32. The subopercula: these are of very peculiar form, and are attached to the anterior faces of the ridges on the opercula bones for rather more than one-half the length of the latter; they decrease in size as they rise, terminating in flatted points which lie close to the opercula; from them extend anteriorly long processes to which fibrous tissue is attached, forming the connection between these bones, the subopercula and epihyals; posteriorly, they are produced into long, fin-like rays, sixteen to eighteen in number, connected by membrane, which gives them a strong resemblance to a fin. At the bases of their anterior processes there are two of the so-called spines. The inferior extremities of the opercula bones extend a little beyond the solid part of these bones, and to about one-third of the breadth, when extended, of the fin-like rays.

33. The interopercula are somewhat triangular in shape, having upon their superior outer extremities peculiarly-shaped processes, to which, at their inner edges is attached the thin tissue connecting them with the preopercula and with the long arms of the opercula bones (not plates). From the superior outer edges of these bones descend their attachment to the epihyals from which thickened branches are sent out to support the anterior angular extremities of the singularly-shaped subopercula bones, and from their anterior extremities strong ligaments attach them to the posterior extremities of the articularies on their inner sides, enveloping at the same time the posterior extremities of the angulars. These bones lie immediately beneath the preopercula, the ossa sympletica (mesotympanic—Owen) and the posterior part of the quadrates.

31. Ossa sympletica (mesotympanic—Owen). These bones lie between the metapterygoids, the preopercula and the forks of the quadrates. They have double anterior margins for the reception of the metapterygoids and the anterior margins of the forks

of the quadrates. They are very thin narrow plates, single at their posterior edges and nearly smooth on their outer surfaces, with an irregular outline. On their under surfaces, at their superior extremities, they have short ridges nearly in their centres, extending downwards about one-third of their length. Against these ridges rest the stylohyals, which are at their upper extremities attached to grooves in the hyomandibulars.

34. The dentaries are long and narrow; at their anterior extremities they are united by symphysis, and support two rows of teeth upon their inner surfaces, one of full size, and the other in various stages of growth; on their lower anterior extremities there are processes for muscular attachment, and on their posterior inner surfaces is the space for *Meckel's* cartilage.

35. The articularies fit into the spaces or grooves of the dentaries. On their upper surfaces the superior anterior faces join the dentaries in sharp points and widen posteriorly to a considerable breadth; at nearly their superior posterior outer edges each has a projecting spine, and on the inner inferior edge processes for connection by ligament with the quadrates; immediately posterior to the spines is the articulation for the condyle of the quadrates. The heads or posterior extremities of these bones extend about one and a quarter inches beyond the anterior edge of the articulation, and upon them rest the spine and the superior part of the broad inferior extremity of the quadrates. From the superior posterior extremities of the dentaries the posterior extremities of the articularies reaching to the anterior edge of the articulation for the condyles of the quadrates rapidly fall, and form a triangular surface, which appears to be for the attachment and play of the maxillaries.

36. The angulars are exceedingly small and thin flat bones, situated on the inner sides of the posterior extremites of the articularies. They have small heads, which are turned outwardly and overlap the articularies.

29. Stylohyals. These bones, as already mentioned, lie in grooves in the hyomandibulars, and are small and somewhat tapering towards their superior extremities and have a ligamentous attachment.

37. Epihyals: these bones are long. At their posterior extremities they are narrow and curved inwards and upwards towards their junction with the stylohyals. They widen out at their anterior extremities, where they present themselves as thin bony plates. On their upper inner anterior edges there is on each a splint, which unites it with its

38. Ceratohyal: these, which are comparatively very long bones, have at their superior anterior extremities processes which connect them with the epihyals, giving to them *in situ* the appearance of having thickened superior edges. The Ceratohyals on their lower posterior extremities present the same thin edges and of equal width with the epihyals. In the anterior third of their length, midway in these bones, on the outer side, is a groove for the reception of part of the branchiostegal rays, of which two on the inner side of the bones are the anterior, and four on the groove mentioned the posterior. At about half their length on the superior surfaces there is on each of these bones a process for their attachment by ligament to the angulars and dentaries, and at this point the bones are twisted so that their inferior are nearly at right angles to their superior extremities.

39, 40. Basihyals: these bones, two on each side form the base of the hyoidean arch; in the *Lophius* they are of irregular shape, and the upper pair present long posterior processes which unite them by sqamuous suture to the inner side of the ceratohyals at their upper anterior extremities; the lower pair are small, thin and somewhat triangular plates, which are attached to the lower anterior extremities of the ceratohyals. In the Cod the lower pair are much the larger bones.

41. The glossohyal, which lies between the basihyals and the

42. Urohyal, which is directly beneath it, are both extremely small bones.

43. The branchiostegals are very long and thin bones. There are six on each side, and in the absence of ribs they serve to form the large abdominal cavity of the Lophius.

53. There are in the Lophius no representatives of the basibranchials.*

* I have not yet found any; but will make further examination as soon as a new specimen is obtained.

56. The lower pharyngeals are flat, and have at their posterior extremities a somewhat spatulate shape, gradually tapering to their anterior extremities, from which points to about one-half of their length they are strengthened by lateral ridges; on their outer and inner edges it may be said there are two rows of teeth occupying the anterior two-thirds of their length, the posterior third is for the attachment of the muscles, and between the rows of teeth the bones are somewhat rough.

57. The hypobranchials are not represented in the Lophius as in the Cod by three bones, but the inferior (anterior) extremities of the ceratobranchials of the three first branchial arches are prolonged curving inwards and posteriorly, and tapering to points they rest in, and are supported by the fibrous tissue of the floor of the mouth.

58. Ceratobranchials—the first three pairs of these bones are thin and delicate and there is a comparatively wide space between their inferior extremities; the fourth pair are longer than the others, but their inferior (anterior) extremities are slight and a short distance apart, but tied together by tough fibrous tissue which also serves to support the inferior extremities of the lower pharyngeals.

61. The epibranchials—the first pair in the Lophius are only short representatives of these bones and they do not rise to the support of the upper pharyngeals, but are attached to the ceratobranchials of the first arch in the usual manner, and to the epibranchials of the second arch, of which they are about one-third the length, their superior extremities fitting into a groove in the epibranchial to which they are also attached by ligament. At about their centres they throw out anteriorly, processes, which are slightly curved inferiorly, for their attachment to the muscles which govern the branchial arches. The second pair of epibranchials are long and slender bones having expansions for the junction of the first pair, and at each extremity for their attachments inferiorly to their ceratobranchials, and superiorly to the anterior division of the upper pharyngeals, immediately beneath the process for the muscular attachment of this division. The third pair of epibranchials taper slightly from their junc-

tions with their ceratobranchials to about midway of their length, they then gradually enlarge until they reach the upper pharyngeals, to the median division of which they give partial support; at their upper third these bones are closely connected with the fourth pair, and are for a short space enveloped by them, in fact forming on each side a nearly rigid pair. At the superior extremities of these bones on the anterior faces of the median upper pharyngeals are processes for their muscular attachment. The fourth pair are longer and very much stronger bones than the others, being at their inferior extremities in proportion to the others as ten to three ; on their posterior edges they are somewhat thin with double anterior ridges ; they decrease in size until they reach the third pair, where they expand with shell shaped processes, which as already stated, partially envelop the bones of the third pair ; at the junction with their upper pharyngeals they are less in size than at the enveloping process, and also tend to support the median division of the upper pharyngeals, while the posterior division may be said to be entirely sustained by them.

62. The upper pharyngeals contain each three plates or divisions (anterior, median and posterior), armed with teeth strongly curved posteriorly. The anterior divisions contain each ten to twelve teeth, and are narrow, having processes on their superior extremities for attachment of their muscles. The median divisions are somewhat triangular in shape, and their superior edges (the bases of the triangles), are more than four times the breadth of either of the other divisions ; they have each on their superior edges a process for their muscular attachment, and each contains from eleven to fifteen teeth. The posterior divisions are also narrow plates ; at their anterior inferior edges they are curved under and connected with the under posterior surfaces of the second divisions ; on their superior edges there are processes for muscular attachment. These divisions contain each from ten to fourteen teeth.

46. In the Lophius the supra clavicle (sometimes called the post temporal) is on each side a broad spatulate plate, thin upon its edges, gradually rising to form a ridge along its anterior

centre: at about one-third of its length from its proximal extremity, the ridge mentioned becomes reduced, and this extremity droops so as to form its articulation immediately beneath the paroccipital and against the exoccipital, thus lying nearly at right angles with the vertebral column.

47. In this fish the interclavicle is not represented.

48. The clavicle is very difficult to describe; from the proximal extremity of its upper limb to midway of the lower limb, lines drawn through the centres of these portions of the bone would in general terms form a right angle; they are not unlike the wooden knee of a ship in the curve formed by the upper and lower limbs, the lower half of the lower limb curving towards the centre of the fish. Upon its proximal superior extremity the bone curves upward, and projecting above the supraclavicle, forms one of the spines of the head. A very long and strong spine rises just above the point of junction with the distal end of the supraclavicle. Upon the outer edge of the clavicle there is also a process for the attachment of the muscles, and at about one-third of the length (from its inferior extremity) of the lower limb of the clavicle, rises the ligament which serves for the attachment of the pelvic limbs.

49. Accessary bone: at the base of the long spine at the upper outer posterior edge of the clavicle, and attached to it, is the accessary bone (post clavicle, of some); it is thin and delicate.

52. Scapula: close to the accessary, and upon the clavicle, and close to its outer edge, is the very small fenestrate scapula, and immediately beneath the scapula, attached to its inferior edge, but lying, its central limb in the centre of what may be called the junction of the upper and lower limbs of the clavicle, is the (51) coracoid, which is an irregularly oval cup-shaped bone, the edges of which are attached to the clavicle, and from its apex a thin process projects angularly towards the outer edge of the clavicle, to which it is attached by cartilage.

53. The carpals, or brachials, in the Lophius, are (on each side) two in number, they are very long and are attached to the scapula, the coracoid, and to the clavicle. The upper carpal being about half the length of the lower, does not bear fin rays,

but serves for the support of the lower carpal, (which is also much stronger than the upper), as well as to the fin rays of the superior edge of the pectoral fin. The lower carpal at its lower posterior half, at the point of junction with the inferior extremity of the upper carpal, has a thin posterior edge which continues to its distal extremity, and round which, beginning at the junction with the upper carpal and continuing to its anterior inferior edge, the twenty-seven rays of the (65) pectoral fin are attached.

80. The pubic bones which support the ventral fins are each attached by a strong ligament to the clavicle (see 48) of its side at its upper edge, about the point where the posterior cartilage enters and is covered by the bone. The iliac portion, if it may so be called, being a shaft (containing cartilage), somewhat flattened at its anterior extremity, decreasing in size towards its centre, from whence it widens out to form the ischio-pubic elements, on the outer edge of which the six fin rays are attached, the posterior (82) five being soft rays, and the anterior ray (81) a comparatively short and strong spine, which has in most cases a slight upward and outward curve.

67, 68, 69. The vertebral column contains twenty-nine vertebræ. The Atlas as already mentioned (under No. 8), supports the supra-occipital; the atlas, axis and the third and fourth centra are wider on their superior and inferior surfaces, particularly the two first named, than the remaining centra which gradually taper to the caudal extremity. The vertebræ interlock on their inferior edges by angular processes, while their superior anterior edges are interlocked or supported by the neurapophyses of each succeeding centrum overlapping the posterior edge of its preceding neurapophyses, and they gradually decrease in size until about the nineteenth centrum, from this point being nearly of the same size to the twenty-seventh. The twenty-eighth and twenty-ninth centra have their superior processes very small, but the inferior interlocking processes are of the normal size. The axis is the shortest centrum in the column, being about half the length of the atlas, and not more than half its height at its outer edges. The twenty-eighth centrum is about the same length as the twelfth, and the twenty-ninth is double the length of any other centrum.

The neurapophyses and neural spines. The processes rising from the atlas and supporting the supraoccipital may probably be looked upon as modified neurapophyses ; those of the axis and third centrum at their inferior extremities having a greater space between them as these centra are wider than the others, the remaining neurapophyses conforming to the centra to which they are attached. The neural spines rise in height gradually from the axis to the ninth centrum, slightly fall at the tenth, maintain their height to the fourteenth, and diminish gradually to the twenty-first ; the twenty-second and twenty-third meet with somewhat rounded points ; the twenty-fourth, fifth, sixth and seventh are again slightly prolonged, but the structure of their posterior extremities is much like that of their centra. The posterior edge of the twenty-seventh centrum shows slight increase in median diameter, but the form of the twenty-eighth centrum is different from that of the others, it is marked by a prominence on its median line at each side, and at its posterior extremity the neural spine overlaps the twenty-ninth centrum for about one-half of its length. The twenty-ninth centrum has, extending for nearly two-thirds of its length from its anterior edge, on each side, a broad wing-like process beginning below the prominences on the twenty-eighth centrum, slightly rounded at its outer edge and drooping a little towards its posterior extremity ; near its superior posterior extremity this centrum is rounded somewhat and flattened, and at its extremity, it is transverse to the vertical line : the termination of this centrum which supports the caudal fin is vertically narrow and perpendicular to the column. The neural spine appears in this centrum to be represented by an intercalated curved bone, the centre of which lies just posterior to a line drawn through the posterior edge of the anterior third of the centrum, and there are two foramina at the base of the neural canal, below the anterior extremity of the intercalated bone.

The two centra twenty-eight and twenty-nine, appear to be the analogues of the sacrum.

The Ventral aspect of the vertebral column: The Axis has no parapophyses, but at its anterior inferior edge a rounded ridge for its articulation with the basi-occipital, and from the posterior edge of this ridge there is an upward curve, which causes the posterior to be in vertical height to its anterior edge as three to five; the curve mentioned is continued in the axis and third centrum, making the vertical height of the three named less than that of the remaining centra, and not affecting the dorsal line.

The centra, from the axis to the fourteenth, gradually increase, and from the fourteenth to the eighteenth, decrease in vertical height; the remainder are nearly of the same height. It may be observed that while in most of the centra the conical cavities are of greater transverse breadth than vertical height, the reverse is the case in some of the posterior centra, with the exception of that between the twenty-eighth and twenty-ninth centra.

Between the basi-occipital and the anterior face of the atlas, the usual conical cavities exist, but the atlas taken by itself is neither amphicœlous nor procœlous, the conical cavity is found in its anterior face, extending deeply into the centrum, and the posterior *facet* has transversely a small anterior curve, but vertically at its central line it has a straight surface, inclining anteriorly, which causes a slight difference in the length of this centrum, between its upper and lower surfaces, the latter or inferior aspect being the shortest. The axis, which is very short, and the remaining centra, are amphicœlous.

The parapophyses of the axis and third centrum are very minute, if even they can be said to exist; they begin to appear on the fourth, and continue to and upon the *ninth centrum.

The hæmal arches are completed upon the tenth and eleventh centra by the coalescence of the hæmapophyses. The hæmal spines appear on the twelfth, thirteenth and fourteenth centra, and following the general line of the vertetral column, each lies in the anterior space between its posterior hæmapophyses. The spine of the * fifteenth centrum at its posterior extremity has a

* This is variable, as smaller and likely younger specimens show. In one the hæmapophyses do not coalesce until the fifteenth centrum; in another upon the eleventh, and in both of the above the parapophyses continue to and upon the tenth centrum, and also these two specimens show the curved hæmal spine upon the fourteenth centrum, these fish had only ten rays in the anal fin.

slight downward curve, and on the sixteenth it has attained its normal length and angle, and from this, to and including the twenty-seventh centrum, the spines gradually decrease in length and angle. The hæmal spine* of the twenty-eighth centrum is much elongated, and is almost parallel with its neural spine, it extends posteriorly beneath the twenty-ninth centrum for two-thirds of the length of the latter.

On the twenty-ninth centrum there is no hæmal spine, unless a somewhat thick and flattened edge on its posterior extremity may be said to represent it. In the wing-shaped processes at each side there is a foramen for the vessels, slightly posterior to the termination of the hæmal canal proper.

74 & 75. Dorsal fins. This fish has two dorsal fins, the first containing six spines, two of which are close together and near the nostrils, and are supported by a very peculiar dermal longitudinal spine situated between the turbinal or nasal bones; looking upon the superior surface of this spine, at its anterior extremity there is a narrow perforated projection which joins the apex of a flat kite-shaped process, the posterior extremity of which terminates in a sharp point curved slightly above the general line of the spine, and beneath which the spine has a flattened superior edge widening to its posterior extremity where it is quite thin and flat. On its anterior half the spine has at its anterior extremity, vertically, a very thin and deep plate, which is strengthened by the flattened edge and process above mentioned; this thin plate at its anterior inferior extremity is rounded, and curves posteriorly towards the middle of the spine and there disappears. As already mentioned the anterior portion of the longitudinal spine lies between the turbinal bones, and its anterior extremity is slightly in advance of the superior processes of the maxillaries; its posterior extremity extends to nearly the centre of the forks of the frontals. The length of the spine varies in different specimens, a small fish having sometimes a proportionately longer spine than a large one. The spine is enveloped by muscles which control its movements, as well as

* In one specimen before me, the length of the spine is nearly one and a quarter inches, while that of the twenty-ninth centrum is one and five-eighths inches.

those of the first and second spinous rays of the first dorsal fin.

The first spinous fin ray articulates with the perforation in the longitudinal spine by what at first appears to be a bony link-joint, but the bifurcated inferior extremities of the fin ray are tied together by a firm cartilage, which, passing through the perforation or ring of the longitudinal spine completes the link-joint. Usually the first fin ray has upon it a fleshy looking lappet, which is supposed to be the bait this fish displays to attract its prey, but another use of it appears to be to warn the fish when it is in shallow water. This lappet is often lost by the fish and is said to be reproduced in a short time ; when the large specimen was caught, it was without this bait, and it is possible that old age may put a stop to the process of recuperation.

The second spinous fin ray articulates with the longitudinal spine at the posterior extremity of the kite-shaped process, and is partially supported by it ; the bifurcated extremities of this ray are much closer together than those of the first ray.

The third or isolated spinous fin ray, rises from the centre of the depression in the bone already referred to as "A," which has upon it a small longitudinal spine for its articulation ; it is much shorter than the first two spinous rays, and in a large specimen, six inches behind the second spinous fin ray. The three remaining, or the fourth, fifth and sixth spinous fin rays cover a space of about three inches, the fourth being about three and a half inches in height, the two others successively shorter ; the fourth ray (in the specimen above mentioned) is distant from the third, four and one-half inches, and all three lie above the vertebral column ; the fourth ray above the neural spine of the fourth centrum, the fifth above that of the sixth, and the sixth ray above that of the seventh centrum, each having also above the column a small and nearly longitudinal spine which carries almost in its centre a small crest, behind which the fin ray articulates.

The second dorsal contains twelve soft rays, supported by twelve (74) interneural spines ; the first spine is inserted between the eleventh and twelfth, and the twelfth between the twenty-second and twenty-third neural spines, and they are strongly bent posteriorly, their anterior faces lying against the posterior edge of their anterior neural spine, while their superior extremities rise above their posterior neural spine. The first ray of the second dorsal is supported by the superior posterior extremity of the first interneural spine, and the anterior face or angle of the second, and so on until the twelfth, which is sustained by the posterior extremity of the twelfth interneural spine, slightly in advance of the posterior extremity of the twenty-fourth centrum ; this last interneural spine is attached by its posterior extremity to the neural spine of the twenty-fourth centrum. The fin rays of the second dorsal, increase in length from the first to the sixth, and then decrease to the twelfth ray.

71. The caudal fin contains eight soft rays, the centre two of which are the longest, and about of equal length ; the upper and lower rays, also of about equal length, are the shortest, and the fin when spread, presents at its posterior extremity a rounded outline. The two divisions of the upper ray on their superior edges, as well as those of the lower ray on their inferior edges, unite, and form each an angular edge, but that of the upper ray is much the stronger.

83. The anal fin and interhæmal spines.

79. The interhæmal spines of the anal fin, are ten in number ; the first lies between the fifteenth and sixteenth, and the last two or ninth and tenth, between the twenty-third and twenty-fourth hæmal spines, that is both on the twenty-fourth centrum. The fish described has *eleven* anal rays, the first of which articulates with the anterior edge or angle of the first interhæmal spine ; the second with the anterior angle of the second interhæmal, and is also supported by the posterior extremity of the first, and thus they continue to the tenth ; the eleventh fin ray is attached to the posterior extremity of the tenth interhæmal spine, immediately beneath the centre of the twenty-fifth centrum. The rays of the anal fin increase in length to, and including the seventh, and decrease slightly to the eleventh. In most specimens, the Lophius presents in the anal fin only ten rays ; in these the first interhæmal spine may be inserted between the fourteenth and fifteenth, or between the fifteenth and six-

teenth, and the last two between the twenty-second and twenty-third, or between the twenty-third and twenty-fourth hæmal spines, in other words upon the twenty-third or twenty-fourth centrum, (I have specimens of both before me), in this case the last interhæmal spine is very short and does not reach the extremity of its posterior hæmal spine.

72. The Lophius has no ribs.

In conclusion, I would mention that the foregoing paper when read, was illustrated, by the disarticulated bones of the skull, &c., as well as a skeleton of a Lophius, together with the disarticulated bones of the skull, and a skeletal head and shoulder-girdle of a codfish (Gadus morrhua).

Art. VII.—On the Ravages of the Teredo Navalis, and Limnoria Lignorum, on Piles and Submerged Timber in Nova Scotia, and the means being adopted in other Countries to Prevent their Attacks. By Martin Murphy, Esq., *Provincial Engineer.*

(Read Monday evening, 13th March, 1882.)

Among the questions which interest the engineer in the Maritime Provinces of the Dominion of Canada, there are none of greater importance than the means whereby the ravages of the Teredo Navalis can be checked or prevented. I think I may say that here, as in many other instances, where the operations of nature interfere with the designs of man, we can only remedy these difficulties by a precise knowledge of their causes, a knowledge which may enable us, if not to check, at least to avoid, some of the evil consequences. We know that innumerable boring animals establish themselves in the lifeless trunk of the piles and other submerged timbers of our wharves, piercing holes in all directions into their interior, like so many augers, penetrating the timber in every direction, until they actually destroy its solidity, and dissolve its connection with the ground. But however efficient these borers may be, science comes to the rescue, and means are being successfully adopted in both Europe and America to not only resist, but to effectually destroy their attacks.

I need only allude to the universal knowledge of the danger to be apprehended, arising from the growth and development of the Teredo within the bearing timbers which support our railway bridges; to the annual loss to both the Dominion and Provincial Governments arising from their destructive powers upon our public road bridges, wharves and breakwaters, to satisfy the most sceptical that a study of this subject is worthy of the deepest scientific interest; and that a minute knowledge of the extent and mode of formation of those belonging to our own shores must be of paramount importance, were it only with reference to the preservation of timber from their attacks. For although efforts are being made to replace our timber bridges by iron, still, when it is remembered that owing to our great extent of sea coast, to the many indentations of the sea, or harbours which run far inland, and that are necessarily crossed over tidal water, and that timber is within easy distance, and labour, skilled in fashioning it into desirable form, is always available, it may yet be a long time before all the timber bridges in this country will be superseded by more permanent materials. The same remarks will more fully apply to the wharves and breakwaters of the Maritime Provinces of Canada; for until timber in this country becomes much more expensive than it is at present, it will be more economical to adopt in many situations the class of wooden structures, or stone and wood, as at present existing.

These facts suffice to show that the reasons so far given for the necessity of investigating the ravages of the Toredo, and the other destructive species of its class, are in themselves a subject well worthy of investigation; and the author of this paper would respectfully solicit the aid of the President and members of this Institute, many of whom are much more conversant with nature and its fauna and flora than he could pretend to be, the object in view this evening being more to explain what is being done by Engineers to prevent, or at least to lessen, the evil consequences of their attacks, than to discuss the several species of molluscs which perpetrate them.

Let us now return from this digression to the consideration, first, of the abode of the Teredo in Nova Scotia.

From a series of investigations for the purpose of this paper, the author is led to believe that the Teredo Navalis, or the Teredo Norvegica, exists all along the shores of this Peninsula. The zone or area of its active operations is, however, confined along the shore bounded by Northumberland Strait, St. George's Bay, Strait of Canseau, Chedabucto Bay, and all round Cape Breton Island. South and West of these places its attacks are not very remarkable, the Limnoria Lignorum being more conspicuous for its depredations along the Atlantic Coast, from Chedabucto Bay to Cape Sable and along the shores of the Bay of Fundy. It is very remarkable that in Nova Scotia the haunts of the Teredo, where its ravages are greatest, indeed where its destruction is very noticeable, are confined to bays, harbours or estuaries that are frozen over from four to five months of the year. From Cape Sable to Cape North, 370 miles, we have a much greater diversity of climate than is due to latitude alone. The influence of the gulf stream on the southwestern promontory gives a milder and more tepid atmosphere, with harbours open all the year round. The influence of the ice floes in the Gulf of St. Lawrence on our northern and more eastern coast, has quite the opposite effect. Here where our harbours or rivers are sheltered from agitation of the sea, they are frozen over, and here is seemingly the place where the Teredo appears to live, thrive and destroy.

At Shediac I have seen a spruce stick, that had been driven as a fender pile to the wharf one year previously, completely honeycombed so that it floated to the surface. I saw living teredos in it from 4 to 6 inches in length. I am sorry I did not know enough at the time, to notice the shell or pallets which distinguish the species.

At Pictou the Teredo is very destructive on both sides of the harbour, almost every piece of submerged timber bears traces of its ravages.

The specimens of its borings obtained from Pictou, which I place before you, leave no doubt that it is the work of the Teredo.

At the Pine Tree Gut, about six miles from New Glasgow, and eight from Pictou, where the railway crosses the tidal estuary, the Teredo has attacked the piles of the railway bridge, which we shall hereafter refer to.

At the marine slip, Strait of Canseau, distinct traces of the work of the Teredo are quite visible.

At Sydney, C. B., every wharf suffers by their depredations, except the pier of the Sydney and Louisburg Railway, which is an example of how their attacks can be prevented. I shall hereafter refer to this structure.

At Louisburg, and at Margaree, they are also quite active, so that I think we may fairly assume that they are to be found in the other harbours intermediate between those places.

Returning to the Strait of Canseau, and proceeding westwardly towards Halifax, we are in the region of the Limnoria Lignorum, and although traces of the Teredo may be found at the ship yards and marine slips all along our shores further south, yet they are neither numerous nor destructive. The wood eating Limnoriæ now become the active agents of destruction. Myriads of them are visible on the piles of our wharves, and on every piece of submerged wood within the zone of their attack. From Whitehaven to Halifax, at Mahone Bay, Lockeport, Shelburne, Yarmouth, St. Mary's Bay and at Digby the attacks of these little borers are vexatiously conspicuous. A pile at the old yacht club house in Halifax Harbour, 12 inches in diameter, was reduced to 6 inches in seven years. Along the Atlantic shore they destroy timber over its submerged surface within the limits of its workings at the rate of about one inch per annum. Specimens from Digby, which I submit, show a much less degree of destruction. Those four specimens of piles, taken from Digby wharf, 13 years submerged, were, when driven, 10, 12, 13 and 15 inches respectively, they are now 6½, 5, 7 and 6 in the order in which they are first named. Along St. Mary's Bay, Annapolis Basin, and Minas Channel, inlets of the Bay of Fundy, the average rate of destruction seems to be about the same as at Digby, namely, about one-half inch on the exposed surface per annum, or about one-half as much as at Halifax, and some other places on the Atlantic coast. In 1877 one of the piers of the Victoria bridge, which crosses Bear River near its confluence with Annapolis Basin, toppled over, owing solely to the borings of the Limnoria Lignorum. It had been constructed about 10 or 11 years, and was erected thus:

1st. Cribs were built of logs, floated to the site of the piers, and there sunk by stone.

2nd. Around the submerged crib-work a single row of piles was driven at a distance of three feet apart centres.

3rd. On the rectangular single row of piles the piers were erected, which then, stilt-like, supported the whole weight of superimposed pier and superstructure.

Many of the piles suffered so much from the attacks of these crustacea, that several of them floated away with the tide, causing the pier to tilt over and carry the bridge superstructure with it into the stream below.

At the lowest spring tides known for that year, I visited the lower trunk of the pier which still remained standing, with the view of having it renewed. Every pile was eaten at the level of low tide to about three inches from the former surface, until its section became so reduced as not to be able to support the superimposed weight above. The timber consisted of spruce, hemlock and pine,—the attacks seemed to be just the same on each, irrespective of kind. I would here mention that the same remarks apply to hardwood, such as black maple and oak.

I will now briefly advert to the animals themselves.

Dr. E. H. Von Baumhauer, Commissioner to the Centennial Exhibition from Holland, in papers published in the "Popular Science Monthly" for August and September, 1878, gives, through the translation of Mr. Andrews, the following very full and interesting description of the habits and workings of the Teredo Navalis, as extracts from the "Archives of Holland" or extracts from the report of the Dutch Commission, on the subject under your consideration.

"Teredos penetrate wood naturally by very small openings in a direction perpendicular to the surface (Figs. 12 and 15–C); then they generally turn about in order to follow the direction of the woody fibres, usually upward, but sometimes downward. Although they do not enter into the earth or mud, one generally finds the first traces immediately above the line of the mud in which piles are driven; it is at this point that piles destroyed by the teredo generally break off.

"When the teredos are lodged in a piece of wood, one recognizes them by very small holes on the surface, and the extremely delicate tubes which project from them (Fig. 12, e, d). These are the siphons, only one of which shows at first, the other appearing later. These siphons are generally kept outside the wood in the water, but the slightest touch causes the animal to retract them. One of them is shorter and larger than the other, but they both seem to serve for the expulsion of the fæces, which largely consist of particles of wood reduced to a very fine powder. It is known that the teredo does not perforate wood for nourishment, but only to procure a suitable abode; the woody substance detached in the boring, passes through the intestinal canal, and then is expelled in the form of a very fine white substance by one of the siphons, generally, according to M. Vrolik, by the shorter, but sometimes by the longer. The long siphon appears to serve principally for the introduction of food, which consists of infusoriæ diatoms, and other inferior animalculæ which the sea-water brings with it into the siphons. It is nevertheless still uncertain whether the matter expelled through the longer siphon comes directly from the intestinal tube, or is at first introduced from outside with inflowing water to be expelled again after a short sojourn inside.

"The Teredo requires for respiration a clear, pure water. It has often been remarked that piles placed in dirty, muddy water, near drains, for example, are protected thereby. The water should have, moreover, a certain degree of saltness; the teredo cannot live in brackish water: that is a point to which we shall return later.

"The Teredo continues to grow in the wood; while the gallery which it forms presents near the surface a diameter of only one quarter to half a millimetre, it enlarges little by little, until it reaches a diameter of five millimetres and more; as regards his length, and consequently that of the tube which incloses him, we have sometimes found it to be thirty to forty centimetres. He never goes upward more than half way between the flow and ebb of the tide; although the teredo is thus, for a short time, partially above the water, yet it appears that the wood holds a sufficient amount of moisture to sustain his life temporarily.

"The researches of Kater have still further shown, what had already been remarked by Sellius, that the Teredo can hibernate in the wood, and that it is those individuals, thus preserved, which in the spring go through with all the phenomena of reproduction —i. e., the formation of eggs, fecundation, development, and expulsion of the young.

"The part of the external integuments which constitutes the mantle deposits a calcareous matter, forming an interior lining to the gallery in the wood (fig.12. f.) Between this calcareous casing and the body of the animal there remains a space sufficient to prevent any inconvenience, at least during the act of respiration, for it is possible that when the Teredo absorbs water, which serves for respiration, his body is distended, and fills exactly the calcareous tube. The form of this tube, secreted little by little, corresponds exactly with that of the gallery, which has been slowly perforated in the wood; it has the appearance, also, of a series of rings placed one against the other. As the animal progresses a new ring is added to those which existed before, so that when the tube is closed at its extremity by a calcareous film, its length represents the total length of the animal. (fig. 12; b to c) Among the segments of the tube, those which are nearest the surface of the wood are the oldest and hardest; in the interior of the wood, where the gallery ends (fig. 12, g), the calcareous ring, newly formed, is at first soft, flexible, and of slight consistency; later, it becomes solid, and closes up the tube, as has been remarked by Sellius.

"The calcareous tube, once formed, constitutes for each Teredo his own abode, where he isolates himself from his companions, and has nothing to fear from their close proximity. One never sees a Teredo pierce the tbue of another. The tubes make their way side by side, and cross each other in every direction, but, be the wood ever so worm-eaten, there always remains a woody wall, often very thin, it is true, between two adjoining tubes."

I think this description by the Dutch Commission is so full and comprehensive, that it leaves but little to add to the mode of sustenance and attack of the animal, which is all I shall advert to here. Suffice it to say, that the characteristics so explicitly described are largely if not fully applicable to the species of Teredo inhabiting our shores.

Let us now return to a review of the habits and attacks of the Limnoria Lignorum, so destructive from Chedabucto Bay westerly and along our Atlantic coast and the shores of the Bay of Fundy.

The piece of pile alluded to taken from the old Club house wharf at Halifax, was sent to me by Mr. Peter Archibald, C. E., Resident Engineer of the Intercolonial Railway. It had been in the water seven years,—was 12 inches in diameter when placed there, and was reduced to six inches by the action of the Limnoria. I received it just as it was taken out; one could observe with the naked eye the crustacea then living. I had it placed in sea water, and sent to Notman's Photographic establishment here to be photographed. The operator found no difficulty in obtaining a negative of the piece of wood which I produce, and enlarging it about four diameters. It was very difficult, however, to find a single perfect specimen; they all died when about one day from their abode in the harbour, and owing to their diminutive size, they had so shrivelled up as not to be recognizable. Fortunately, Rev. Dr. Honeyman had a specimen which I obtained, and which is shewn enlarged about four or five diameters; it is procured from the same neighbourhood. Two views are shewn, the dorsal and ventral.

Owing to the vrey able and comprehensive description of the Limnoria Lignorum given by Professor Baird, in his Report of the sea fisheries of the south coast of New England in 1871–72, we are able to place this wood borer in the order of its species as one of the crustacea. At page 379 Dr. Baird says:

"Of Crustacea, the most important is the Limnoria Lignorum. (p. 370 Plate VI, fig. 25) This little creature is grayish, and covered with minute hairs. It has the habit of eating burrows for itself into solid wood to the depth of about half an inch. These burrows are nearly round, and of all sizes up to about a sixteenth of an inch in diameter, and they go into the wood at all angles, and are usually more or less crooked. They are often so numerous as to reduce the wood to mere series of thin partitions between the holes. In this state the wood rapidly decays, or is washed away by the waves; and every new surface exposed is immediately attacked, so that layer after layer is rapidly removed, and the timber thus wastes away and is entirely destroyed in a few years. It destroys soft woods more rapidly than hard ones; but all kinds are attacked except teak. It works chiefly in the softer parts of the wood, between the hard, *annual layers*, and avoids the knots and lines of hard fibre connected with them, as well as rusted portions around nails that have been driven in; and, consequently, as the timbers waste away under its attacks, the harder portions stand out in bold relief. When abundant it will destroy soft timber at the rate of half an inch or more every year, thus diminishing the effective diameter about an inch annually.

"Generally, however, the amount is probably not more than half this; but even at that rate, the largest timbers will soon be destroyed, especially when, as often happens, the Teredos are aiding in this work of destruction. It lives in a pretty narrow zone, extending a short distance above and below low water mark. It occurs all along our shores from Long Island Sound to Nova Scotia. In the Bay of Fundy, it often does great damage to the timbers and other wood-work used in constructing the brush fish-weirs, as well as to the wharves, &c. At Wood's Hole it was formerly found to be very destructive to the piles of the wharves. The piles of the new Government wharves have been protected by broad bands of tin plate, covering the zone which it chiefly affects. North of Cape Cod, where the tides are much greater, this zone is broader, and this remedy is not so easily applied. It does great damage, also, to ship timber floating in the docks, and great losses are sometimes caused in this way. Complaints of such ravages in the Navy Yard at Portsmouth, New Hampshire, have been made, and they also occur at the Charlestown Navy Yard, and in the piles of the wharves at Boston. Probably the wharves and other submerged wood-work in all our sea ports, from New York northward, are more or less injured by this creature, and if it could be accurately estimated, the damage would be found surprisingly great.

"Unlike the Teredo, this creature is a vegetarian, and eats the wood which it excavates, so that its boring operations provide it with both food and shelter. The burrows are made by means of its stout mandibles or jaws. It is capable of swimming quite rapidly, and can leap backward suddenly by means of its tail. It can creep both forward and backward. Its legs are short and better adapted for moving up and down in its burrow than elsewhere, and its body is rounded, with parallel sides, and well adapted to its mode of life. When disturbed it will roll itself into a ball. The female carries seven to nine eggs or young in the incubatory pouch at one time.

"The destructive habits of this species were first brought prominently to notice in 1811, by the celebrated Robert Stephenson, who found it rapidly destroying the wood work at the Bell Rock light house, erected by him on the coast of Scotland. Since that time it has been investigated, and its ravages have been described by numerous European writers. It is very destructive on the coasts of Great Britain, where it is known as the "gribble."

If we contrast the destructive powers of the two most remarkable wood borers inhabiting our shores we find a great diversity in size, form, mode of operation, mode of existence and attack.

The Teredo, as we find it, is from four to six inches long, and about $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter. The Limnoria is about 1-16 to 1-8 of an inch in length, and about one half that thickness. The Teredo is long and vermiform; the Limnoria is short and ovate. The Teredo bores to make itself a house. The Limnoria bores for existence. The Teredo lives on the infusoria of the water; the Limnoria on the substance of the wood itself.

The Teredo attacks from the outside, and penetrates into the heart of the timber; the Limnoria attacks from the outside only, and rarely more than one half an inch, until the cells are destroyed by the water, when it renews its efforts and destroys again.

From these facts it will be seen that the preventive measures to be taken in order to counteract the attacks of these two classes of borers, should be quite different. For instance: the means to be devised for the preservation of wood from the attacks of the Teredo in the harbour of Pictou should be entirely different (preventively considered) to those which should be employed in the harbour of Halifax. To arrest the destruction going on by the Limnoria Lignorum, one means must be used so as to permeate every pore of the wood internally; the other need only to be applied externally, so as to fill up the half inch cavities or cells visible on the outside of the timber, or both destroyers may be warded off by a metallic covering, so as to prevent them from attacking the wood at all.

That the Teredo existed in Europe, in a geological period earlier than our own, does not admit of a doubt. At Belfast, Ireland, 12 feet under the surface in a blue argillaceous soil beneath a series of strata of shells, in the London clay, in the Eocene formations at Brussels, and also near Ghent, fossil wood containing the remains of the Teredo has been found.

An idea prevails that the Teredo was imported from abroad through vessels coming from the East Indies to Europe; but this is said to be an erroneous impression. The same idea prevails here, that it was imported from the West Indies through the same means, and it may be found equally fallacious. It is obvious that the Teredo in Nova Scotia does not seek the most southern and warmest haunts.

One of the circumstances favoring the ravages of the Teredo is said to be saltness of the water; it is not found in brackish water here; and owing to the narrowness of our Peninsula (not more than 100 miles at the most) the small consequent water sheds, and the small volume of water poured from them into our harbours, we cannot say much on this point. I have, however, nowhere observed the Teredo active near fresh water.

The Teredo finds himself exposed to the attacks of an annelide which is constantly found wherever the Teredo exists. His eggs and embryos are met with in the midst of those of that mollusc.

Kater has remarked that the adult annelide leaving the muddy bottom where he has hibernated, and in which the piles are driven, climbs along the surface of the wood toward the opening made by the teredo; there he sucks away the life and substance of his victim; then, slightly enlarging the aperture, he penetrates and lodges in place of the teredo. All the early writers on this subject state that they have found this annelide in wood at the same time with the teredo. It is remarkable that a similar annelide, and perhaps the same, has been found in the cavities hollowed out in stone by the pholades.

We have an annelide in Nova Scotia that hibernates in winter as represented, and is busy in our mussel beds in summer. I cannot say whether it is the species or not alluded to by M. Andrews. I have not heard of its being found in the cells of the teredo.

Experiments in the preservation of wood from the attacks of the Teredo.

The trials made by the Commission may be placed under three principal groups:

1. Coatings applied to the surface of wood, or modifications of the surface itself.

2. Impregnation of wood with different substances, which modify the interior as well as the surface of the wood.

3. Employment of exotic woods, other than ordinary woods of construction.

Coatings applied to the surface of wood. The methods belonging to this group; which have been examined by the Commission, are the following:

1. Method invented by M. Clawren, and kept secret by the inventor.

2. Metallic paint, invented by M. Clawren, and likewise kept secret.

3. Method of M. Brinkerink, consisting of a mixture of Russian talc, resin, sulphur, and finely powdered glass, applied hot

on wood previously roughened by a toothed instrument; this application was two millimetres thick.

4. Method of M. Ripurjk, analogous to the preceding.

5. Paraffine varnish, obtained by the dry distillation of peat, from the factory of M. M. Haages & Co., at Amsterdam.

6. Coal tar applied cold on the wood in several successive layers, or applied hot on wood whose surface had been previously carbonized. Some pieces were treated as follows: Holes were first bored in them and filled with tar; then plugs were fitted closely to the holes and driven in with sufficient force to make the tar penetrate the wood; other pieces still were painted over with a mixture of tar with sulphuric acid, or sal ammoniac, or turpentine, or linseed oil.

7. Painting with colours mixed with turpentine and linseed oil, among others, with chrome-green or with verdigris.

8. Singing or superficial carbonization of the wood.

The pieces of wood thus prepared were placed in the water at the end of May, 1859, and the first examination, made toward the end of September of the same year, showed that neither of these methods afforded any protection from destruction by the Teredo. There was one partial exception, and that was the piece of wood treated according to No. 6; these showed only traces of the Teredo here and there. But at a later examination, in the autumn of 1860, when the wood had been exposed a year and a half, these were also found to be equally severely attacked by the Teredo.

The results of these experiments strongly convinced the Commission that no exterior application of any nature whatever, or modification of the surface merely, would give any efficacious guarantee of protection against the teredo. Even supposing that one or another of these means would prevent the young teredo from attaching themselves to the wood, yet the constant friction of the water or ice, or any accident, might break the surface of the wood sufficient to give access to the teredo.

This seems a proper place to mention a practice in general use in Holland for warding off the teredo; this consists in covering wood with a coat of mail made of nails. This operation is very costly; for, to really protect wood in this way, it is important that the square heads of the nails join exactly; for insuring the best results, the armoured piles are exposed in the open air for some time before being placed in the water, that rust, forming on the surface of the iron, may close up the interstices inevitably remaining between the heads of the nails. But this precaution is not infallible, as the Commission examined piles more than once, in the course of its investigation, which had been several years in the water, and whose surface was entirely incrusted with rust more than a centimetre thick, but which were, nevertheless, eaten in the interior by the teredo.

Impregnation of wood with different substances. The Commission examined in this category the following methods:

1. Sulphate of Copper.
2. Sulphate of Protoxide of Iron (Green vitriol).
3. Acetate of Lead.
4. Soluble Glass and Chloride of Calcium.
5. Oil of Parafine.
6. Oil of Creosote. This is, as is very well known, a product of the dry distillation of coal tar, separated by distillation from the more volatile parts, which serve for the preparation of benzole and naptha, the residuum being pitch. Experiments had already been tried abroad, as well as in Holland, with this substance, and from the beginning of their experiments the Commission paid especial attention to this very important method of preparation.

Wood of various kinds, prepared with creosote oil, at the works of the Society for the Preservation of Wood, at Amsterdam, was placed in the sea in the month of May, 1839, at Flessingue, Harlingin, and Stavoren, the pieces of oak, pine and red fir, were found intact, while those unprepared were perforated. In the month of October, of the same year, the pieces of creosoted pine and fir at Harlingin showed a perfect state of preservation. At Harlingin the treated and untreated pieces were fastened together; the teredo penetrated the latter, but had not touched the creosoted wood. The same was true of the creosoted wood at Stavoren, when visited in 1859.

At Nieuwendam in March, 1859, three pieces each of oak, pine, and red fir, all creosoted at Amsterdam, were exposed in the sea. They were examined in September of the same year. They had been fastened together by cross pieces of unprepared wood; it was found that the teredo had penetrated, at the juncture of these cross pieces, even into the creosoted wood, and that sometimes he stopped immediately beneath the surface; at others he penetrated to a depth of several millimetres; in the oak, he worked his way into the interior through those parts of the surface which were not in contact with the unprepared wood.

Experiments with creosote oil were recommended in July, 1860, with ten pieces each of oak and red fir, following the plan indicated in paragraph 5; the localities chosen were Kieuwe-Diep and Stavoren; in the latter place the pieces which remained intact the previous year were again placed in the water after their surface had been removed by the adze. Still later in August, 1861, a further trial was made at these same places, with pieces of pine, beech and poplar, sent to the Commission by Mr. Boulton, and prepared at his works in London. All these pieces were examined toward autumn in 1862, 1863 and 1864; while the unprepared pieces, placed near the others as counter-proof, were found each year filled with teredos, one could not discover any traces of the teredo in the creosoted pieces except in the oak creosoted at Amsterdam; in cutting these it was found that the creosote had penetrated them very imperfectly. A third examination in 1864, showed that all the pieces prepared by Mr. Boulton, and which had been exposed in the sea since August, 1861, were entirely intact; the most careful examination could not show the slightest trace of the worm, even in the pieces withdrawn from the water in 1862 and 1863, and each time scraped to a depth of several millimetres and again placed in the water. They resisted the attacks of the teredo perfectly.

Conclusions. By way of recapitulation, the result of the experiments, tried by the Commission during six consecutive years, were as follows:

1. The different coatings applied to the surface of wood, with the design of covering it with an envelope on which the young

teredo cannot attach itself, offer only an insufficient protection; these coverings are likely to be injured either by mechanical means, such as the action of the water, or by being dissolved by the water. Just so soon as a point of surface of the wood is uncovered, be it ever so small, the teredo, still microscopic, penetrates into the interior. Covering wood with sheets of copper or zinc, or with nails, is a too expensive process, and only protects the wood so long as they form an unbroken surface.

2. Impregnation with inorganic, soluble salts, generally considered poisonous to fish and animals, does not protect wood from the attacks of the teredo.

3. Although we do not know with any certainty if among exotic woods there may not be found these which will resist the teredo, we can affirm that hardness is not an obstacle which prevents the mollusc from perforating his galleries; the ravages observed in wood of guaiacum and mamberlak prove this.

4. The only means which can be regarded with great certainty as a true preservative against the injury to which wood is exposed from the teredo, is the oil of creosote; nevertheless, in employing this means care is necessary that the oil be of good quality, that the impregnation be thorough, and that such woods be used as will absorb oil readily.

The conclusions arrived at by our Commission are confirmed by the experience of a large number of engineers in the Netherlands, and also in England, France and Belgium. M. Crepin, a celebrated Belgian engineer, expresses himself thus, in a Report on experiments tried at Ostend, under date of February 5, 1864:

"The result of our experiments now seems decisive, and we think we can draw from them this conclusion: that soft woods, well prepared with creosote, are protected from the attacks of the teredo, and are in a condition to assure a long dura tion. The whole matter, in our opinion, is reduced to a question of thorough impregnation with good creosote oils, and the use of such woods as are adapted to the purpose. It has been found that resinous woods are impregnated much better than other varieties."

Mr. Fourtier, a French engineer at Napoleon-Vendu, in a report dated March 3, 1864, makes a resumé of experiments conducted by himself in the port of Sables d'Olonne, in the following words:

"These results fully confirm those established at Ostend, and it seems to us difficult to refuse to admit that the experiments at Ostend and Sables d'Olonne are decisive, and prove in an incontestable manner that the teredo will not attack wood properly creosoted."

"Under date of Haarlem, April 20, 1878, Prof. Von Baumhaur, writes to Edward R Andrews, of Boston: 'I have deferred answering your favor of the 22nd of February, until I had corresponded with the chief engineers of the Waterstaat as to the results obtained in their experience in the use of creosoted timber in all our marine works, in large quantities, and during some tens of years. They all unanimously agree that the teredo will not penetrate timber thoroughly impregnated with creosote; but that, to obtain the best results, the work must be thorough, as they had observed that the teredo had destroyed piles only superficially infected.'

"Fir, if the sap be first withdrawn in a vacum and then treated with hot oils under a heavy pressure, can be most thoroughly creosoted; but oak is more difficult. Still, I have often seen heavy oak piles where the creosote had entered into the very heart."

In a paper read by Mr. Burt, before the Institute of Civil Engineers, London, upon the nature and properties of timber, with a description of the methods then in use for its preservation, after reviewing John Howard Ryan's, Sir William Burnett's, and Payne's process, then in use, he proceeds to say:

"One hundred parts of coal tar contain, when submitted to distillation, 65 parts of pitch, 20 of essential oil (creosote), 10 of naptha, and 5 of ammonia. The oil produced from this distillation is the creosote of commerce, now so extensively used for preparing timber. The preservative properties of this material appear to be threefold.

First. It prevents the absorption of moisture in any form, or under any change of temperature.

"Secondly. It is noxious to animal and vegetable life; thereby repelling the attacks of insects and preventing the propagation of fungi.

"Thirdly. It arrests the vegetation or living principle of the tree, after its separation from the root, which is one of the primary causes of dry rot, and other species of decay.

"The attention of the author of the paper referred to, was first called to this subject in 1841, in consequence of having practiced the process, to some extent, for Mr. John Braithwaite (M. Inst. C. E.), on the Eastern Counties Railway. The works, in that case, were of the most primitive and incomplete description; nevertheless they answered the purpose, and the sleepers, prepared at Heybridge, eleven years ago, are as sound and perfect as the day they were laid down, although they are of Scotch fir, and not of very good quality. Since that time, being extensively engaged in preparing timber, many improvements have been made in the machinery and apparatus, and in the method of preparation.

"Creosote is at present used for preparing timber, either under pressure in strong closed cylinders, or by placing the timbers in open tanks, and keeping the solution up to a temperature of 120° to 150° until the required quantity is absorbed. Creosote has the property of crystallizing when the temperature is below 35°, and it becomes a hard compact mass of salts. It was in consequence of this peculiarity, and the difficulty of using it in the winter season, that peat was resorted to; and was done in the first instance by making a common fire-place at one end of the reservoir, and running a flue under the bottom. This system was, however, exceedingly dangerous, because the oil came in contact with the heated iron plate, and the temperature could not be raised beyond 70° or 75°, or only just sufficient to enable the work to be continued conveniently during the cold weather. The experiment was then tried of allowing high pressure steam to blow into and upon the creosote in the reservoir; by this means the temperature was raised as high as was required, and it has continued to be used. Where a steam engine is used for working the pressure pumps, the waste steam can be employed to heat the creosote, by passing it through a coil of pipe laid in the bottom of the reservoir. This mode of heating was first adopted at Mr. Bethell's works at Battersea, and it answers admirably.

"The cylinder now used in the ordinary process is similar to a steam engine boiler, 6 feet diameter, and from 20 feet to 50 feet long. Formerly the end or charging doors were made in a variety of ways, some to open inwards, some to slide in air-tight grooves, and others similar to the cover of a gas retort. Nothing, however, answers so well as to have the cover of the full size of the cylinder, with proper fastenings, and all the joints accurately turned and fitted together, for the pressure on so large an area is enormous, and the heated oil is so exceedingly subtle, that great care is necessary to prevent leakage. Small trucks run on rails inside the cylinder and carry the load. These formerly ran out upon a long switch, and were then turned into a siding and unloaded. A different plan is now adopted, by making the inside lorries run out upon another larger and stronger truck of the ordinary gauge, so that by this means they can be run on to any of the adjacent sidings, to be unloaded without shifting a second time.

Since 1853 the process then described by Mr. Burt, as creosoting under pressure in strong cylinders, has become the favorite one to adopt to resist the attacks of the teredo. The same process, with slight modifications, is carried out to this day, both in Europe and America.

The Dutch Commission speak most favorably of it.

English engineers, such as Hawkshaw, Burnett, and others, speak of it from time to time in the Reports of the Transactions of the Society of Civil Engineers, in a very favorable manner. American engineers generally recommend its adoption.

But no better example could be desired of the efficiency of creosote to prevent the attacks of the teredo, than we have in the Harbor of Sydney, Nova Scotia. Here the teredo is seemingly as destructive, if not more so, than at any place on our coast, and here, about ten years ago, a coal-loading pier was erected sufficiently large that three ocean-going steamers could load coals at the same time. The pier runs out into the harbor; it was erected entirely of pine timber, creosoted in Great Britain, and sent out here. It has most effectively withstood the ravages of the teredo, whilst all other piles in the neighborhood had to be renewed twice.

Not satisfied with reports about its permanency, so far, I requested that the Sydney and Louisburg Coal and Railway Company would have an examination made for the purpose of this paper. I have to-day a telegram from Mr. D. J. Kennelly, Q. C., managing director of that Company, in which he says: "Creosoted pier absolutely sound; ten years erected. Timber not creosoted twice renewed."

One of the objects of this paper is, firstly, to point out the necessity which exists for a creosoting apparatus to be placed in Nova Scotia, somewhere in the region of the Teredo's most active operations; and, secondly, that experiments be conducted by some responsible parties, as to the best means to adopt to arrest the ravages of the Limnoria Lignorum.

Considering the interests at stake and the great annual loss to the Department of Public Works, Canada, from these destructive animals, one would think that something should be done in the public interests, by at least investigating the matter, and with the view of proper remedial measures being taken so far as practicably possible, to mitigate or prevent their ravages in the future.

Art. VII.—Shore Birds of Nova Scotia. By Bernard Gilpin, A. B., M. D., M. R. C. S.

(Read April 10th, 1882.)

In studying the immense flocks of what are called Shore Birds, which yearly appear during July, August and September of each year upon the flats of the Bay of Fundy, St. Mary's Bay, the Tuskets, and Digby Basin, in Nova Scotia, we must consider them as migratory birds, breeding, with few exceptions, in the Polar regions, and now returning with their young to warmer latitudes, reaching even the Gulf of Mexico, and thus passing our

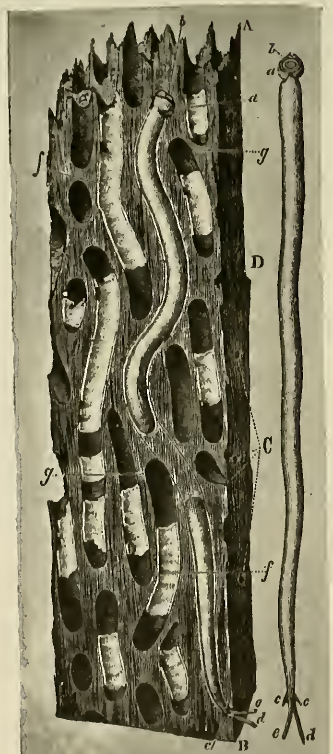

Fig. 12.—Wood exposed from November, 1874, to September, 1876, in crib at Pier No. 1, New York, North River, twenty-five feet below mean low tide.

Fig. 14.—Spruce submerged two years in Coal Mining Company's wharf, Middle River, Pictou, N. S., four feet below low water.

Fig. 14.—This cut was made from a *Teredo navalis*, taken from a pile exposed two seasons (1876 and 1877) at Horn Island, Gulf of Mexico. When first taken from the wood it was eighteen inches long.

FIG. 15.—Hemlock from Yacht Club wharf, Halifax Harbor, N. S., attacked by Limnoria Lignorum. Enlarged 4 diameters.

FIG. 16.—Photograph of piece of spruce pile from Halifax Harbor, N. S., containing living Limnoria and Mussels.

shores. They are generally in imperfect moult, having lost their nuptial plumage, which is not yet replaced by their winter one. Few full plumaged males appear, but females, imperfect males and young. Hence the difficulty of classing them. The pursuit of food alone urges them on their migration southward, whilst that of reproduction swept them onward in the spring to the fierce North. The spring route is more direct, more inland, and more quick. We see nothing of them during spring. The most obvious, and those which from numbers and from sight most modify our landscape, are the sand peeps (sand pipers, tringa), and next them the ring necks (the plover). These two speck the feathery margins of our salt-estuaries, whitening our flats and flashing like silver clouds in the air. Next in number come the larger plover, golden plover and beetle heads, which migrate in sufficient numbers to modify our landscape. The other species must be looked for by the naturalist, and from their numbers are scarcely noticed, save by the sportsman, or naturalist, and yet in their aggregate great numbers pass us. I have thought the members of the Institute would be interested in a description and classification of all these birds, the numerous as well as the more rare, and therefore in this paper shall give only what I have seen personally myself, of all the various shore birds that pass our shores during the autumn. I do not doubt that some have evaded my notice, or that I have found a difficulty in classification in others, yet the work of an eye-witness is always valuable. I shall use the Smithsonian nomenclature (Dr. Coues), thinking it the best, but finding some difficulty even in it, to say nothing of Nuttal, Wilson, and the older naturalists, in properly arranging all my species. Of the vast flocks which, as I said before, modify our landscape, I have found from a study of years, from minute measurements and accurate coloured drawings, that they are composed of two species of ring neck plover, and three distinct of sand peeps, or sand pipers, all in common in huge flocks.

The ring necks are the American ringed plover, Æ semipalmatus, and Æ melodus, piping plover. Of the sand peeps, with the utmost study, I have only found three species, the less sand piper (Tringa minutela), the greater sand piper (Tringa Bairdii), and the semipalmated sand piper, E pusillus. It is with the greatest doubt I make this classification, as I think Tringa Bairdii too recent a nomenclature for a bird so well known. In Nuttall's work, so singular for its truth, he marks the Stint, a bird that I have never seen here or any sand peeps with any lateral tail feathers white. Besides in his descriptions and measurements he confounds at least four species. I shall minutely describe the two species of the Ring plover as I find them here, only saying that they as well as the sand peeps were selected from a heap of dead, brought in from shooting, and containing all five species of Ring plover and sand peeps in one stiffened mass.

Common Ring Plover shot at Digby, N. S., August 12, 1876:

Length, $7\frac{1}{6}$ inches.
Wing to wing, 15 inches
Bill, $\frac{5}{8}$ inch.
Tarsus, 1 inch.
Toes, $\frac{7}{8}$ inch.

The bill was high at base, nostrils basal black at tip, dull orange at base, legs and toes dull orange, nails black, joints pencilled black, no hind toe, toes joined at base with webs, outer web nearly double the inner. In colour, forehead, chin, neck running behind the head, all below and inside the wing, white. Above head, hind head, back, shoulders and wing coverts, olive brown. The forehead is black, holding within it a white spot, and running beneath the eye to the lores. A deep black collar, nearly an inch broad and running insensibly at the back into brown, surrounds the neck. Tail, when closed, black, sides of rump lightest; tail of twelve feathers. Outside feather white outer edge, more or less white on tips of four outside feathers, middle feathers black at ends; primaries, secondaries, and tertiaries more or less dark with white shafts, coverts tipped obscurely with white. Some specimens had scarlet rings around the eyes, some not. The olive brown colour and the semipalmated and orange foot, determine their species very easily, as the semipalmated plover of Wilson, and the Ægialites semipalmatus of Coues. Another Ring neck shot in August, 1876, differed from these in colour of body, size and colour of legs, and not having semi-palmated feet. In colour it was white below, and pale bluish ash above, with no brown or olive tint. The signs of black or of ring about the neck were very slight, and light dusky. The middle tail feathers were black, tipped white at the end, and there was a white stripe through primaries, secondaries and tertiaries. The bill and feet black and shorter than in the true ring plover, and the whole bird smaller. On searching for these birds I found they went by themselves, were scarcer, and hard to get. I have classed them, with some doubts, with the charadius melodus of Nuttall and Wilson, and Ægialitis melodus, Coues, thinking the difference of leg, bill and colour were from imperfect or young birds. We may generally conclude that the semi-palmated variety is very common, and individually found in brightest colour of olive brown, yellow feet and red ring about the eye; that he always assorts with the peeps; is found at high water, emarginating the shores, waiting for the ebb to bare the flats, over which he spreads himself; and that he appears sparingly in July, numerously in August, and leaves in September. Of the second species you think them plenty; but searching for them, you find them scarce—though found in company with the peeps. All these birds have doubtless lived at the north, and are passing our shores with their females and young. As I saw a few breeding on Sable Island with the peeps and terns, though not determining their species, I think that increasing population, and not choice, may send them so far north. All due allowance must be made for imperfect moult and young birds.

After writing a description of these Fall birds I have had an opportunity of examining three specimens of this plover, Egialitis melodus (Coues), shot April 24th, 1882, at Digby, N. S., and in full nuptial plumage. Mr. Downs also has a group of the adult birds and young, shot near Halifax, proving that it breeds with us, though the greater numbers that appear in Fall must prove it also to be migratory.

Extreme length, 6 6-10 inch.
Wing spread, 14 inch.
Length of bill, ½ inch.
Length of tarsus, 7-10 inch.

Colour of bill yellow, with black tip; toes and legs yellow, but palms and toes slightly pencilled dark, yellow ring about the eye. Head, back, wing coverts and rumps ashey grey, but coverts with slight black shading, each feather with a white edge. Forehead white, with a black band above, a black collar going round the back, but more or less incomplete in front. The cheeks whitish with ashey wash, showing small black spots beneath and behind eye. In one specimen the black collar was entire around the throat; chin, hind neck, breast, belly and all below white. Sides of rump white, middle tail feathers black with light tips; lateral tail feathers white, 2nd lateral tail feathers white, 3d inner white, with a black spot in it, the other lateral ones having black bands on the extremities, but near the body white. Shaft of the primaries and secondaries white. The primaries black upon the outer van, but having a white streak running through them and the secondaries, and joining the lower edges of the greater wing coverts and tertiaries. The tips of primaries and secondaries were black, the wings not reaching the end of tail in dead bird. The eye was black with yellow ring. No hind toe, inner toe cleft to base, scarcely a web between outer and middle toes. This is the nuptial plumage of the piping plover, differing sharply in colour, and not having semi-palmated feet, from the semi-palmated species, and agreeing with the imperfect Fall birds. I have not noticed Wilson's plover in Nova Scotia.

Of the sand peeps I have been able after years of study, measurement and coloured drawings, to determine but three species. It will better serve the interests of truth for me to describe these species from my own note book, rather than attempt a classification with the older or more modern naturalist. Those who are willing to wade through my paper will, I am certain, have a true history of the Nova Scotian Species.

Small Sand Peep, Aug. 23, 1876, Digby:

Extreme length, $5\frac{3}{8}$ inches.
From wing to wing, $11\frac{5}{8}$ inches.
Length of bill, 6-8 inch.
Length of tarsus and toes, $1\frac{5}{8}$ inch.

Toes not connected by membrane at base, hind toe small; legs pale greenish-yellow. General colour, head, neck, back and coverts dark sepia, the edges of each feather margined with a lighter or rufus brown. The rump sooty-black, reaching to end of closed tail, which is margined with rufus. Primaries, secondaries and tertiaries blackish, edges light, which, with white shafts, gives the appearance of a faint white line down each feather. Wing coverts edged with white; faint dark line from mouth through the eye; a broad faintish-brown collar about the breast; beneath, to end of tail, white; bill blackish.

Another shot 20th September, 1880, at Digby, gives—

Length, $6\frac{1}{4}$ inches.
Length of bill, $\frac{3}{4}$ inch.
Of tarsus, $\frac{3}{4}$ inch.
Wings spread, $11\frac{1}{2}$ inches.

Colour: forehead, neck, back of neck, shoulders black, more or less, but each feather with an edging of light ferruginous, on neck and head less, but greater upon shoulders, wing coverts and tertiaries, the whole effect being black spots with a decided ferruginous wash. The rump and middle tail feathers black, a little white showing on either side of rump; the edging of tail feathers ferruginous, the side tail feathers lighter than middle ones. Chin, and obscurely above eye, whitish, a very obscure dusky line from bill to eye; neck to breast grey, pencilled black, forming distinct colour. Below white to vent. The outside shaft in the first primaries white.

A Sand Peep shot at same time, 20th September, 1881, measured:—

Length, $8\frac{3}{4}$ inches.
Length of tarsus, 15-16 inch.
Length of bill, 1 inch.
Stretch of wing, $16\frac{1}{8}$ inches.

Though the greater size showed directly a different species, yet I could find no difference in colour betwixt these than that the wing coverts above the secondaries in the smaller were more broadly edged with white. The bills in both were alike and black nostrils basal, upper mandible with a sulcus running half way to tip. Legs and feet in both dark brownish, four-toed and palmated; hind toe slight and inserted above the palm. In their figures coloured they resemble each other in the well stained neck and front, absence of ash and hoariness, and presence of ferruginous tints. Thus I must conclude that I have two species akin in all but size, one ranging from five to five and a half inches, the other from seven and one-half to eight inches, both four-toed and without webs. Richardson, under the species pusilla, may mean the last one as well as Wilson, by the size.

But amongst these flocks I found a third sand peep, which was not only semi-palmated, but different in colour from the others.

Shot 5th Sept., 1881. Bay of Fundy:—

Length, 6 inches.
Spread of wing, $11\frac{1}{4}$ inches.
Length of tarsus, nearly 1 inch.
Length of bill, $3\frac{1}{4}$ inches.

Colour on back and top of head, shoulders and wing coverts greyish, interspersed with black streaks and spots, spots more on back and shoulders; rump black, tail greyish, the upper and lower tail coverts nearly as long as the tail. A small white streak behind the eye, and spotted line of dusky from bill to eye; throat and all beneath white, bill black, legs black with olive wash; toes palmated, inner web smaller than outer. In comparing this species with those shot 20th Sept., and nearly of the same dimensions, but not semi-palmated, we find no ferruginous tints, rump not so black, breast whiter, and with very slightly marked collar, colour of legs more olive. In this specimen the shafts of both primaries and secondaries are white, also the tips of the wing coverts. But upon the nonsemi-palmated, both greater and less, we find the white bar upon the wing, broader, and formed not only by the wing coverts, but also the primaries and secondaries, as it was joined in the white mark. This bird has come down to us "semi-palmatus," from Hutchins, Wilson, Richardson, Nuttall, and Buonaparte; yet Coues gives it as pusillas, without giving his reasons. It certainly is the only semi-palmatus I have found frequenting the Nova Scotia shores in a study of years; is very well marked, which shows more when the coloured drawings of each are opposed to each other.

The next birds which may be said from their numbers to modify our landscape are the plover, the green or golden plover, and the larger beetle heads. They usually migrate together, and are seen with us from August and September, a few lingering till November. Heavy south-west gales confuse them, and mass them in numbers as they prepare to light, during the gale, in the fields and on the shores. The large kind rather affect the fields, the smaller kind the shores. It is very seldom you meet a male in full plumage, or black breast and belly. Their usual colour is spotted greenish on the back, with black splotched beneath. Coues denies the greenish or yellow wash upon the larger species, but my note, Sept. 20th, 1881, gives this yellow wash upon their backs. I have also observed a black spot beneath the wing, near the shoulder, as typical of the larger species. The fourth toe, or nail, in the larger, wanting in the smaller, is the best mark to determine the young from each other as they approach each in colour and size. A very handsome male in full nuptial plumage, with deep black breast and vent, may be seen in the Halifax Museum, of the larger species. Though in the thousands which annually pass us during the autumn, I never have found one.

Of the various other birds of this family that pass us in numbers, there are so few that the sportsman or naturalist only observes them. We may notice the Sanderling whose appearance at Digby I note during September, in his usual grey dress. The Killdeer very rare, having a single notice of him during March, at Halifax. The Turnstone cosmopolites, appearing everywhere, are seen at Digby during September. The Avoset I saw at St. John, killed there, and in Mr. Carnal's collection. The three different kinds of Curlew I have determined. The larger great billed Curlew seen by myself Sept., 1870, at Windsor, N. S.; the Esquimau Curlew, and the smaller Esquimau Curlew, distinguished from the last by its size, and not having the wings beneath barred as in the last.

My notes give September for all these species. The cape Curlew I have noted Halifax, October. Tringa subarquata, Schinss sand piper, I note Halifax, Oct., 1864, but I am not certain. The pectoral sand piper Sept., 1865, Halifax, and afterwards at Digby. The buff breasted sand piper I note Provincial Museum, Halifax, and the purple sand piper at Halifax. The knot or ash coloured sand piper, Sept., 1880 and 1881, in winter plumage. The semi-palmated Snipe or Willet, Digby, June, 1877. Both species of the yellow shanks, the larger and the lesser, are both common in September. Of the tattlers, the solitary or green rump tattler is common; barn snipe as it is called from its solitary haunts about barn pools, and the spotted tattler, is common everywhere. Of Bartram's tattler, or the grass plover, I note one specimen, and that from Sable Island, 1868. This brings us to the Godwits, both species of which, Marbled and Hudsonian, I have noted, the Hudsonian shot, in August. The brown or red breasted snipe is the last autumn visitor I will mention as noted in September.

I have never met with the Dunlin or Ox bird in Nova Scotia, nor do I mention the Phaloropes, though I have seen them and think we have two species, certainly the rose colored one, but am not able to identify them. Wilson's snipe and the Woodcock are common residents, breeding here, the latter plenty, though it requires a good dog, gun, and quick shot to find them. I have seen a bag of twelve or thirteen couple made by my son in a few hours, besides grouse and hares, when he combined all these attributes at one time. A wounded woodcock that I kept by me was lively at night, and always kept its tail spread and crested like a fan over its back. In this paper I have given only my own personal observations of what was seen in Nova Scotia. No doubt many species of North American birds do not pass our shores. In endeavouring to clear the vexed story of the peeps or sand pipers I have thought it best to describe the only three well marked species that I have noticed; and to say that however numerous or varied other North American species may be, I have not found them here. To attempt to class our species here with those of Wilson, Nuttall, or Richardson, is to immediately fall into a crowd of stints, pigmies, lesser pusilla, minor sand peeps, all of which seem to have the same measurement and colouring. Amongst these the semi-palmata seems to stand out boldly in different colour and semi-palmated feet; yet Coues returns this bird under the name of pusilla to the old group, and without giving his reasons, which no doubt are good, if known, but unknown cannot stand before Hutchens, Nuttall, Richardson, Wilson and Buonaparte. In his key of North American birds had he put the first discoverer's name to the specific, as he has done to the generic name, it would have added much to the value of a very useful work. Naturalists owe him much for sweeping away the too numerous genera in the gulls and penguin ducks as Darwin calls them. I mean the very restricted genus of Scoter so like in colour, bills and habits.

List classed after Dr. Coues.

Squartolinas helvitica—Beetle head.
Chavadius fulvus—Golden plover.
Ægialitis vociferus—Kildeer.
Ægialitis semi-palmatus—Ring neck.
Ægialitis melodus—Piping plover.
Strepsilus interpres—Turnstone.
Recurvirostra Americana Avoset.
Machtoramphus griseus—Red breasted snipe.
Ereunictes pusillus—Semi-palmated peep.
Tringa minutella—Least peep.
Tringa bairdis—Baird's peep.
Tringa maculata—Pectoral sand piper.
Tringa maritina—Purple sand piper.
Tringa subarquata—Curlew sand piper.
Calidris arenaria—Sanderling.
Limosa fedora—Marbled godwit.
Limosa Hudsonia—Hudson Bay godwit.
Totanus semi-palmatus—Willet.
Totanus melanolcucus—Great yellow shank.
Totanus chloropus—Lesser yellow leg.
Totanus solitarius—Solitary tattler.
Tringoides maculata—Spotted tattler.
Actiturus bartremius—Bartram's tattler.
Tryngites rufessens—Red breasted sand piper.
Numenius longirostres—Long billed curlew.

Numenius Hudsonius—Hudson's curlew.

Numenius borealis—Esquimaux curlew.

I have not mentioned in this list Schinze's sand piper, although my notes give him at Halifax, August, 1864. I have no distinct recollection of the bird, or of seeing Dunlin's, an enlarged copy of it, in Nova Scotia. It is very rare here or not a true species. I think there is Dunlin immature bird in the Halifax Museum. Of all the shore birds that grace our landscape, as I have before said, the peeps are the most pleasing. The great Bay of Fundy-tide that has rushed in almost cataract force through the oppossing traps in the gut, now expanded in the Basin fills to the utmost brim with a power though unseen yet quite as great, every rushy estuary, and every silver sand flat of the great basin. All is steeped in one bright glancing and quivering calm. The peeps are lining the edges of the flats waiting for the ebb. The great herons have come from their heronry twenty or thirty miles on the borders of a tangled spruce lake, waiting for what the ebb may leave them. The barking, and rising and falling of the crows, and squeaking of the herons from their roosts on the over-hanging trees tells that the hawk (F. Columbarius), like a privateer, is backing and filling and waiting his ebb, too near them. These sights and sounds come down upon you as the first soft ebb floats your canoe down the bay. If you are out pot shooting, the noiseless current floats you down towards the flats, now rapidly showing out of water, and covered by thousands innumerable of creeping forms. The whole host, scared by your approaching canoe, with a sharp whistle rise, stretch landward a few rods, then rise in the air and open into a white sparkling cloud, reflecting the bright sunbeams. Now is your time; both barrels of your breech-loader, and the mitraille of mustard seed shot cover the water around with the dead and dying. To slowly pick up the dead and secure the living you turn homewards. From twenty-five to thirty birds, ring necks and plover of several species, are enough to vex your cook and serve for a pot-pie. But if you are out for a pic-nic, and stowed beneath the bear robes, on the very bottom of your canoe, are your wife and little ones, and camp kettles and tea, bread, milk and sugar, and the charming July sun tempts you, you give way for the mouth of the basin, where the huge boulders of traps stem the Bay of Fundy tides, heaping great sand beaches at their bases. Your canoe grits upon Indian beach, you run it up amidst dozens of other Indian canoes, and scan half way up the rocky barrier a shady spot for your bivouac. Here your Indian builds his fire, two parallel lines of stones eighteen inches high, with a trench between, picks and cleans his birds, and cutting branches from the nearest tree, impales a bird on every twig, resting the whole branch over his fire. Gravely he hands to each guest a branch with its roasted fruit, who, holding the branch in one hand pulls with the other the birds from the twigs. To one who has eaten of this Abyssinian banquet there is no need to tell of their tenderness and juicy delicacy. The rigor mortis has not yet stiffened the dead birds. This comes on after a few hours and then passes off after a day or two. If you cook the grouse shot upon your tramp for your night's supper, you are surprised how tough they are, but if you hang them in your camp for a day or two you find them tender. The Indian, like the Abyssinian, chooses the almost living flesh for his feast.

ARTICLE IX.—"THE NORTHERN OUTCROP OF THE CUMBERLAND COAL FIELD." BY EDWIN GILPIN, A. M., F. G. S., F. R. S. C., ETC.

(Read May 8th, 1882.)

MY object this evening is to lay before you a brief summary of the work which has been done on the northern outcrops of the seams of the Cumberland Coal Field. Some of the information is new and of importance, but for much of the work done at an early date I have had recourse to official sources.

The Cumberland coal field was for many years an unknown and unpromising district. It was accessible by water at the Joggins only, to allow competition with the coals of Sydney and Pictou. The presence of coal seams was known at several other points, but the want of any means of transportation forbade an attempt to open them.

Under the influence of a temporary demand for coal in the United States, several mines were opened between Maccan and the Joggins; but they were abandoned as soon as the necessity ceased that called them into operation.

When, however, the long dreamt of Intercolonial Railway was opened through the centre of the field, a fresh and more lasting impetus was given to the coal trade. A large and flourishing mine was opened at Springhill, through the energy of some merchants of St. John, who have been well rewarded for their enterprise in taking hold of a property which was rejected by the people of Halifax. The demand for fuel at the Londonderry iron works has led to the opening of another colliery, and other properties are being prepared to meet the revival of business in the mineral we are now considering.

In view of this encouraging state of affairs, it may not prove uninteresting to you to learn not only what progress in development has been already effected, but to consider what additional stores of mineral wealth may be contained in the district treated of in this paper.

The key to the general structure of the Cumberland coal field is found at the Joggins, presented in a beautiful and unbroken section of the various divisions of the carboniferous system. This has been carefully studied and minutely described by Dr. Dawson and the late Sir Charles Lyell, and I shall refer to it so far as may be necessary to show its bearing on the distribution of the productive measures over a district 25 miles in length. On referring to Dawson's "Acadian Geology," we will find the Joggins' coal-measures bounded above (geologically speaking) by a set of massive sandstones (the upper coal measures), and below by a series of sandstones, grits and conglomerates (the Millstone grit). These massive covers, like the pasteboard of the book-binder's art, serve not to hide, but to preserve the material contained between them. The following summary, in descending order, will show the relative thickness of these great layers of sediments:

UPPER COAL MEASURES.

Upper part......................	650 feet.	
Lower "......................	1607 "	
	——	2267 feet.

PRODUCTIVE COAL MEASURES.

Upper part	2134 feet.	
Lower "	2623 "	
	——	4757 feet.

MILLSTONE GRIT.

Upper part	2000 feet.	
Middle "	3240 "	
Lower "	640 "	
	——	5880 feet.

The lower part of the Upper Coal Measures is exposed at Ragged Reef, where it is made up chiefly of hard and massive gray and white sandstones, with occasional beds of a reddish colour, and red and gray shales.

The upper part of the Productive Coal Measures comprises about 1000 feet of gray sandstone, and nearly the same thickness of gray and reddish shale and fire clays. It contains 22 coal beds, all of which are thin and of poor quality as exposed on the shore, and will not be again referred to in this paper.

The lower part of the Productive Measures, holding all the workable seams yet known on the shores, is characterised by gray sandstones, and gray and dark coloured shales.

The Millstone Grit series forms an abrupt change in appearance to the measures holding the coal beds. It consists of reddish shales and red and gray sandstones, the latter passing into fine grits and conglomerates. It is, moreover, destitute of coal, and shows very few fossils beyond a few drifted pieces of wood.

The following section of the lower part of the Productive Measures shows the principal coal beds and their relative positions :—

	Feet.	*In.*	*Feet.*	*In.*
Strata	339	7	—	—
Main Seam	——	—	7	7
Strata	75	0	—	—
Queen Seam	——	—	4	10
Strata	968	0	—	—
Coal bed	——	—	4	0
Strata	18	—	—	—
New Mine Seam	——	—	3	0
Strata	1160	—	—	—

Only two of the above seams, namely, the main and new mine, are considered workable at the Joggins. We therefore have this vast thickness of strata, comprising 4757 feet, yielding in its upper half no seams worth mentioning, and in its lower part only four beds meriting the miner's attention..

In considering this great mass of sediments, with its alternating layers of coal, clay, sandstones and limestones, it must be borne in mind that the various changes chronicled at the Joggins did not necessarily extend over the whole of the Cumberland coal field. But, as Dr. Dawson remarks, had we visited the district during the coal period, we might, by changing our position a few miles, have passed from a sandy shore to a peaty swamp, or the margin of a lagoon. The evidence of similar districts at the present day, and the sections of their coal fields, show that, although these changes would be visible in passing over the ground, still the horizons of deposition, whether of vegetable matter or of sandstone, etc., vary very little, and that the persistence and regularity of the coal beds is greater than that of the associated measures. We thus find in Cape Breton coal seams preserving over considerable areas a uniform size and relative position while marked variations are observed in the thickness of the containing beds. Had we visited the district we are considering at a period coinciding with the formation of one of the coaly beds, we would have seen on all sides vast swampy plains covered with dense forests of strange shapes and unknown hues; calamite brakes and peaty bogs, traversed by sluggish streams and shallow lagoons, impeded and changed in their course by the luxuriant and encroaching vegetation. Again, a visit at the time of deposition of some of the great beds of barren sandstones would have shown us a wide and shallow sea filled with sandbars and low islands, on which grew straggling calamites, fighting for an existence amid the shifting sands.

We may now briefly pass in review the sections of the seams presented at the various mines which have been opened on the eastern extension of these strata.

Near the shore the Joggins main seam presents the following section recently measured by myself:—

	Feet.	In.
Coal	2	10
Coal and shale (holing)	0	5
Shale	2	6
Coal	1	10
Total	7	7

At the face of the most easterly workings, the parting has diminished to 4 inches.

The New Mine seam presents the following section:

	Feet.	In.
Coal	1	4
Coal and shale	0	4
Coal	1	1
Fireclay	0	4
Coal	0	3
Total	3	4

At the Victoria Colliery, a section is presented which does not agree with any seen on the shore three miles distant, viz:—

		Feet.	In.	Feet.	In.
No. 1 Coal				1	10
Strata				15	0
No. 2 Coal				3	0
Strata				50	0
No. 3 Coal	Coal	0	6	5	2
	Shale	1	4		
	Coal	1	2		
	Shale	0	10		
	Coal	1	4		

A mine is being opened by the Minudie Coal Company, on a seam underlying those worked at the Victoria Colliery by about 900 feet. This seam presents the following section:—

	Feet.	In.
Coal	1	8
Shale	0	10
Coal	1	10
Total	4	4

This seam is apparently the same as that shown in the preceding section, intervening between the Queen and New Mine seams.

At the next colliery, the Lawrence, there are two seams, each 2 feet 6 inches thick, separated by 20 feet of strata.

At the Maccan Colliery there are three seams, presenting the following section :—

		Feet.	In.	Feet.	In.
No. 1 Seam	Coal, coarse..	0	8	2	4
	Coal, good....	1	8		
Strata				100	0
No. 2 Seam				1	8
Strata				300	0
No. 3 Seam	Coal, good...	0	2	4	0
	Shale, ...	0	4		
	Coal, " ...	0	10		
	Shale, ...	1	6		
	Coal, " ...	1	2		

At the Scotia mine two seams have been worked. The upper one is 2 feet 9 inches thick. The lower one, separated from the other at the slope by 10 feet of rock, presents the following section :—

	Ft.	In.
Coal (impure)	1	3
Coal	0	11
Shale	0	4½
Coal	1	5
Shale	0	1½
Coal	0	11
Total	5	0

This parting of ten feet rapidly diminishes to the eastward, and the seams unite on the Chignecto area.

At the Chignecto mine, now being opened by the Steel Company of Canada, the same seam presents the following section :—

	Ft.	In.
Coal	1	0
Shale	0	2
Coal	1	0
Shale	0	1
Coal	0	6
Shale	0	1
Coal	0	3

Shale	1	0
Coal	1	3
Shale	0	3
Coal	2	1
Shale	0	3
Coal	1	2
Total	9	3

At the St. George mine the same seam presents a somewhat similar section, viz :—

	Ft.	In.
Coal (several thin partings)	3	6
Shale	2	0
Coal	0	3
Shale	0	1½
Coal	1	3
Shale	0	2
Coal	1	9
Shale	1	10
Coal	0	11
Total	11	9½

At the Styles' mine the following section of seams has been proved in ascending order, and is from information given me by Mr. James Hickman :—

1st Seam		2	0
Strata		12	0
2nd Seam	Coal ..1 ft. 10 in.; Shale ..0 ft. 6 in.; Coal ..1 ft. 2 in.	3	6
Strata		18	0
3rd Seam	Coal ..3 ft. 6 in.; Shale ..0 ft. 10 in.; Coal ..1 ft. 8 in.	6	0
Strata		30	0
4th Seam	Coal ..2 ft. 0 in.; Shale .. 8 in.; Coal .. 10 in.	3	6
Strata		8	0
5th Seam		1	10

This section represents the seams extending from the Styles

Brook to the St. George mine, a district about five miles in length. This end of the coal field will, from its proximity to the railway, and the regularity of the strata, prove an important future source of coal.

These sections differ widely, and in addition to this there are numerous faults known on the River Herbert areas. A heavy fault is also reported on the west line of the Styles area. We thus find that the seams cannot with any show of reason be correlated with either of the coal-beds worked at the Joggins, so far as their sections are concerned, and the presence of heavy faults prevents a satisfactory comparison between those of areas separated by a short distance.

Dr. Dawson considers the seams at the Victoria Colliery (already referred to) as representing the New Mine seam, the coal bed (given in the section) lying eighteen feet above it, and another coal bed 35 feet below it, containing three feet of coal and shale as represented in the Joggins section. He also compares the Chignecto seam with the bed lying eighteen feet above the New Mine seam, and he further suggests that the equivalent of the main seam is yet to be found in the eastern part of the district.

The work of the Geological survey has brought out new facts, which support his opinion as to the probable position of the Joggins main seam, while they oppose his correlation of the seams already given.

On approaching the Styles mine from the north a band of fine grained conglomerate is met, composed largely of syenitic, quartzite, and slate pebbles, the whole having a greenish and red colour. The thickness of this conglomerate and some associated beds of red shale is about 1,500 feet, and it is underlaid by about 1,000 feet of chocolate coloured shales and sandstones.

This bed of conglomerate has been traced from a point several miles east of the Styles mine nearly to the Maccan River, and throughout this distance it preserves the same characteristics, and appears to form the summit of the Millstone Grit. There is also, as mentioned by Mr. McOuat, another point supporting this view, that is, the underlying chocolate coloured shales are seldom exposed, and have been eroded into a depression to the north of the conglomerate, recalling the great mass of soft strata lying between the upper part of the Millstone Grit and that section of it which furnishes the Joggins grindstones.

The Styles, St. George, Chignecto and Scotia seams all occur at a vertical distance above this conglomerate of 450 to 500 feet. We thus find ourselves provided with a clue at each end of this coal field, and the conclusions to be drawn from the facts I have endeavoured to give you in the briefest possible manner, are of considerable importance in their bearing on the coal values of the district.

On referring to the section of the Productive Measures, it will be noticed that the New Mine seam, which Dr. Dawson considered on the same horizon as the Victoria and Chignecto seams, is 1,100 feet above the Millstone grit. The equivalents, therefore, of the seams found at the Styles and other eastern mines must be sought for in the Joggin section, half way between the New Mine seam and the Millstone Grit.

There is a coal bed found at the Joggins 520 feet above the Millstone Grit, presenting the following section, viz :—

	Ft.	*In.*
Coal	0	4
Shale	1	6
Coal	0	6
Shale	1	3
Coal	0	1
Total	3	8

This may, so far as our data extend, be considered the equivalent of the eastern seams. It would then appear, that, if the conditions necessary for the formation of coal beds were as favourable in the eastern part of the district as they were at the Joggins, workable coal beds would be expected to exist on the horizons of the New Mine and main seams, respectively 1180 and 2289 feet above the Millstone Grit. Judging from the thickness of the seams known in the district east of the Maccan River, these conditions have been more favorable than at the Joggins; and there would, as the thickness of the measures and their characteristics remain practically unaltered, be reasonable ground for expecting to find the different seams better adapted for the miner's work than at the Joggins.

I have already spoken of the Ragged Reef sandstones forming the upper cover of the Productive Measures. This sandstone, occurring in massive beds, overlaid by red and gray shales and sandstones, has been traced into the eastern district. From the report of Mr. McOuat, already quoted, it appears that it crosses the Maccan River below Athol, and strikes the Little Forks River about a mile below the Styles Brook, and follows the course of the river to a point about a mile beyond the post road.

The vertical thickness of Productive Measures between the base of this sandstone and the Millstone Grit is, at the Joggins, 4757 feet; at the Styles Brook, 4500 feet, equivalent at the latter place to an interval of about a mile, measured horizontally. From the course of the conglomerate, which turns to the south about three miles beyond the Styles mine, it would at no great distance run under the sandstone. This is accounted for by the officers of the Survey on the supposition of a great fault, an upthrow to the east, probably of several thousand feet. There are other methods by which this apparent obliteration of the Productive Measures can be explained, but the discussion would make this paper too long.

This district affords a capital illustration of the principle that Nature never yields her secrets to the efforts of individuals confined to limited districts. Explorations had been carried on for years in ignorance of the fact that to the north of the Productive Measures the line of the Millstone Grit had been drawn clearly and distinctly; and that to the south an equally distinct barrier defined the area in which the prospector would legitimately exercise his skill and perseverance.

The work of the Geological Survey in this coal field, for some unexplained reason, was left incomplete, but so far as it has been carried in the Northern district, useful hints have been given to the prospector, which I have endeavored to place plainly before you.

We have seen that at the Joggins, the workable seams and the most promising coal beds are confined to the lower part of the Productive Measures; while the upper half lying immediately below the Ragged Reef sandstones appears to be worthless. So far as I am aware, this set of rocks has not been systematically explored, and its coal contents east of the Joggins are problematical. However, as we have seen that the coal values of a certain horizon in the lower portion have improved to the east, we may anticipate that it is quite within the bounds of possibilities that conditions favorable to the accumulation of workable seams of coal have occurred through this long stretch of coal measures.

Having thus briefly discussed the known seams, and the possible future greatly enhanced value of the district, it remains for me to draw attention to the qualities and transportation facilities of the seams already noticed, with the proviso that any seams found in the future will be more favourably situated for outlet than those now proved.

The distance from the Intercolonial Railway to the furthest east point yet proved in the district is 3 miles. This distance gradually diminishes until the Railway enters the productive belt, and traverses it for a distance of about 1½ mile. By this road a ready outlet is furnished to shipping at Dorchester, 29 miles from Maccan.

The Maccan and Herbert Rivers furnish good shipping facilities for vessels up to 300 tons burden, and at the Joggins coal is loaded into vessels directly from the mines.

I regret to say that at the time I prepared for the Newcastle Institute of Mining Engineers, my paper on "Canadian Coals," I was unable to procure a set of samples of these coals for analysis. I give the following from Dr. Dawson's "Acadian Geology" and other sources, which show the general character of the seams :—

JOGGINS.

Moisture	2·50
Volatile Combustible Matter	36·30
Fixed Carbon	56·00
Ash	5·20

MACCAN.

Volatile Matter	37·00
Fixed Carbon	59·18
Ash	3.82

STYLES.

	Fast coking.	*Slow coking.*
Moisture	4·05	4·05
Volatile Combustible Matter	33·72	38·18
Fixed Carbon	55·83	51·37
Ash	6·40	6·40

The Dominion Government have made arrangements for surveying a line of railway from Maccan to Barnes' Creek, on the river Herbert, and thence to the Joggins, a total distance of about nine miles. This line of road would prove a valuable feeder to the Intercolonial Railway, and an important outlet to the whole Cumberland coal district. It passes across and skirts the productive belt nearly the whole way. By it, in winter, the Joggins, Minudie and other mines would find an outlet to New Brunswick and the Upper Provinces. In summer, the Maccan, and Springhill, and other mines, would find by this road an outlet to a shipping port much nearer than Dorchester and Parrsboro', and open for a longer portion of the year.

The Joggins coal, I presume almost unknown in Halifax, is when carefully prepared a good steam coal. During this year the company have contracted to supply coal for a line of steamers calling at St. John. I am not in possession of any data as to its qualifications for gas and coke making.

The coal from the Scotia and Chignecto seams has found a ready market as a good lasting house coal, and its adaptability for that important use, iron making and working, is shown by the selection of the Chignecto property by the Steel Company of Canada as a fuel supply. The coal from the Styles seam is also well adapted for domestic use, while from trials made on the Intercolonial Railway, it would appear to be a good steam coal. From its action while burning it should also possess good cooking qualities. This point however can be settled satisfactorily only by practical tests.

I do not know that there is more that I can add to this brief sketch of an important, but still almost unknown district, but will feel satisfied if I have been able to convey to you, and ultimately to the general public, any information which will serve to draw attention to the resources of our Province, and to place on record data which may possibly be utilized by future explorers

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