Proceedings and Transactions

OF THE

NOVA SCOTIAN

INSTITUTE OF NATURAL SCIENCE,

FOR

1883, 1884, 1885, 1886.

VOLUME VI.

HALIFAX, NOVA SCOTIA:

WILLIAM GOSSIP, 87 GRANVILLE STREET.

1886.

INDEX TO VOLUME VI.

TRANSACTIONS.

GEOLOGY AND MINERALOGY.

ZOOLOGY.

BOTANY.

PHYSICS.

MISCELLANEOUS.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. VI. PART I.

Provincial Museum, Oct. 11, 1882.

ANNIVERSARY MEETING.

JOHN SOMERS, M.D., F.R.M.S., *President, in the Chair.*

INTER ALIA.

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

President—JOHN SOMERS, M.D., F.R.M.S.

Vice-Presidents—ROBERT MORROW, Esq., MARTIN MURPHY, C. E.

Treasurer—W. C. SILVER, Esq.

Secretaries—Prof. D. HONEYMAN, D.C.L., ALEXANDER MCKAY, Esq.

Council—J. B. GILPIN, M.D., WM. GOSSIP, AUGUSTUS ALLISON, J. M. JONES, SIMON D. MCDONALD, JAS. R. DEWOLFE, M. D., EDWIN GILPIN, WM. M. HARRINGTON.

ORDINARY MEETING, November 13, 1882.

The PRESIDENT *in the Chair.*

The PRESIDENT delivered an address in which the status and valuable work done by the Institute were pointed out, and encouragement given to new workers in various fields yet open to scientific research.

Prof. HONEYMAN, D.C.L., read a paper "On the Micro-Polariscopic Investigation of the Crystalline Rocks of the Gold-bearing Series of Yarmouth." After some remarks by Prof. LAWSON, the meeting adjourned.

ORDINARY MEETING, December 11, 1882.

The PRESIDENT *in the Chair.*

Prof. LAWSON, Ph. D., LL. D., read a paper, entitled, "Notice of some New or Rare Plants."

Prof. D. HONEYMAN, D. C. L., read a paper on "Chebucto Nullipores, with *attaches*."

The PRESIDENT announced that JOHN Y. GUNN, Government Inspector of Schools for Inverness and Cape Breton, had been elected Associate member by the Council.

SPECIAL MEETING, January 2, 1883.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

INTER ALIA.

A letter was read from the Royal Society of Canada, inviting the Nova Scotian Institute of Natural Science to send a delegate to the next meeting of the Royal Society.

On motion of Messrs. GILPIN and JACK, it was

Resolved, That the Institute cordially receive the communication of the Royal Society of Canada, and that they agree to carry out the request of the Society by electing a delegate.

ORDINARY MEETING, January 8, 1883.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

Dr. SOMERS, the *President,* read a paper "On the Anatomy of the Heart of a Moose."

Prof. HONEYMAN, D.C.L., read a paper "On Nullipores."

SPECIAL MEETING, 31st Jan., 1883.

JOHN SOMERS, M. D., *President, in the Chair.*

INTER ALIA.

The Committee appointed to prepare a letter in reply to the letter of the Royal Society of Canada, reported as follows: "At the last meeting of the Nova Scotian Institute of Natural Science, it was resolved that the Institute reciprocate the friendly greeting of the Royal Society of Canada, and agree to elect a delegate to the Society in accordance with the request embodied in their letter of the 17th Nov., 1882."

WILLIAM GOSSIP, Esq., was elected.

ORDINARY MEETING, 12th Feb.

JOHN SOMERS, M. D., *President, in the Chair.*

INTER ALIA.

Prof. HONEYMAN, D. C. L., read a paper "On Glacial Transportation in Nova Scotia and Beyond,—Problem of 1873 solved."

The PRESIDENT read a paper "On the Winter Food of the Partridge (Bonosa umbellus), and on Partridge Poisoning."

It was intimated that Dr. McKenzie had been elected an Associate Member and Capt. England an Ordinary Member.

ORDINARY MEETING, 17th March.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

INTER ALIA.

A letter was read from the Royal Society of Canada announcing the second session to be held at Ottawa, on the 21st day of May next, and requesting the titles and abstracts of papers to be sent in before the 15th.

SIMON D. MACDONALD, F. G. S., read a paper "On Sable Island."

Prof. LAWSON, Ph.D., LL. D., read a paper "On New and Rare Plants of Nova Scotia and Ferns of Bermuda."

SPECIAL MEETING, 22nd March.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

ORDINARY MEETING, 9th April.

ROBERT MORROW, Esq., *Vice-President, in the Chair.*

INTER ALIA.

EDWIN GILPIN, Esq., A. M., read a paper "On the Analysis of a Pictou Coal Seam."

Prof. MACGREGOR read a paper "On the Resistance to the Passage of the Electric Current between amalgamated Zinc Electrodes and weak solutions of Zinc Sulphate."

ORDINARY MEETING, 14th May.

JOHN SOMERS, M. D., *President, in the Chair.*

Prof. HONEYMAN, D.C.L., being absent, his paper "On the Geology of Nova Scotia,—Halifax and Colchester Counties. Part 1," was read by the Secretary.

The PRESIDENT read a paper "On some additions to the Flora of Nova Scotia."

A. MCKAY, *Secretary.*

LIST OF MEMBERS.

Date of Admission:			
1873.	Jan.	11.	Akins, T. B., D.C.L.. Halifax.
69.	Feb.	11.	Allison, Augustus, Meteorologist, Halifax.
77.	Dec.	19.	Bayne, Herbert E., Ph. D., Prof. Chemistry, Royal Military College, Kingston.
64.	Nov.	7.	Brown, C. E., Halifax.
67.	Sept.	10.	Cogswell, A. C., D.D.S., Halifax.
72.	April	12	Costley, John "
63.	Oct.	26.	DeWolfe, James R., M.D., L.R.C.S.E.
82.	May	8.	Fox, John J., Halifax.
78.	Jan.	30.	Geldert, J. M., Barrister, Halifax.
73.	April	11.	Gilpin, Edwin, F. G. S., M. R. S. C., Government Inspector of Mines, Halifax.
63.	Jan.	5.	Gilpin, J. Bernard, M. D., M.R.C.S.L., M.R.S.C., Annapolis.
63.	Feb.	5.	Gossip, Wm. *Vice-President*, Halifax.
63.	Feb.	5.	Downs, Andrew, M.Z.S., Taxidermist, Halifax.
83.	Mar.	12.	England, Captain.
			Forbes, John, Starr Manufacturing Co., Dartmouth.
			Foster, James G., Barrister, Dartmouth.
81.	Dec.	12.	Hare, Alfred, Bedford.
82.	April	10.	Harrington, Wm., Halifax.
82.	April	10.	Harrington, D., M.D., Halifax.
63.	June	17.	Hill, Hon. P. C., D.C.L., Halifax.
66.	Dec.	3.	Honeyman, Prof. D., D. C. L., *Secretary*, Curator of the Provincial Museum, Halifax.
74.	Dec.	10.	Jack, Peter, Cashier of People's Bank, Halifax.
63.	Jan.	5.	Jones, J. M., F.L.S., M.R.S.C., Berwick.
82.	April	10.	Keating, G. H., C. E., City Engineer, Halifax.
64.	March	7.	Lawson, G , Ph. D., LL. D., F.C.I., Professor of Chemistry and Mineralogy, Halifax.
81.	Mar.	14.	Macdonald, Simon D., F.G.S., Halifax.
77.	Jan.	13.	MacGregor, J. G., D.Sc., F. R. S. E., M.R.S.C., Prof. of Physics, Dalhousie College, Halifax.
72.	Feb.	5.	McKay, Alexander, *Secretary*, Supervisor of Halifax Public Schools.
78.	Nov.	11.	McLeod, John R., Demerara, West Indies.
78.	Jan.	11.	Mellish, John T., A.M., Halifax.
77.	Jan.	13.	Morrow, Geoffrey, "
72.	Feb.	13.	Morrow, Robt., Halifax.

Date of Admission:

70. Jan. 10. Murphy, Martin, C.E., Provincial Engineer, Halifax.
79. Dec. 29. Neal, W. H., Halifax.
65 Aug. 29. Nova Scotia, the Right Rev. Hibbert Binney, Lord Bishop of Halifax.
82. April 10. Plunkett, C. W., C.E., Halifax.
79. Nov. 11. Poole, H. S., Assoc. R.S.M., 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., Sup't of Prov. Lunatic Asylum, Dartmouth.
65. Jan. 8. Rutherford, Jas., 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., Prof. of Physiology and Zoology, Halifax Medical College.
81. Dec. 11. Burbidge, D. H., Halifax.

ASSOCIATE MEMBERS.

77. May 14. Burwash, Rev. John, A.M., Charlottetown, P.E.I.
82. June 9. Douglas, John
81. Dec. 12. Gisborne, F. H., Ottawa.
81. Nov. 13. Harris, C., Prof. of Civil Engineering, Royal Military College, Kingston.
75. Nov. 9. Kennedy, Prof. King's College, Windsor.
71. Jan. 11. McKay, A. H., B.A., B.Sc., Principal of Pictou Academy.
82. Mar. 31. McKenzie, W. B., Moncton, N. B.
83. Mar. 12. McKenzie, O. H., Inspector of Schools, Parrsboro'.
61. Dec. 8. Morton, Rev. John, Missionary of the Presbyterian Church of Canada, Trinidad.
78. Mar. 12. Patterson, Rev. George, D.D., New Glasgow.
81. Mar. 14. Stearns, T. G., Middleton, Annapolis Co.
80. May 10. Walker, James, M.D., St. John, N.B.
82. Oct. 1. Gunn, John Y., School Inspector, C. B.

CORRESPONDING MEMBERS.

71. Nov. 29. Ball, Rev. E. Tangier.
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.—Notes on a Polariscopic Examination of Crystalline Rocks of the Yarmouth Gold-Bearing Series.—By Prof. Honeyman, D.C.L., &c. *Curator of the Provincial Museum.*

(Read Nov. 13, 1882)

The problematical character of those rocks, and their unexpected appearance in the gold bearing series—no similar rocks appearing elsewhere in the band, as far as observed,—led me to have sections prepared by A. A. Julien, New York, for microscopic and polariscopic examination.

1, 2. The rock at *Jebogue Point* has suggested a number of queries. (*Vide* Paper on " Geology of Digby and Yarmouth Counties." *Trans.* 1880.) Its appearance and relations suggested a comparison with the Igneous rocks of the Blomidon series. I had also a section made of Blomidon Basalt. The two examined by the polariscope are so much alike as to be regarded identical. The dark material of both is evidently Augite, and the clear crystals a triclinic feldspar. The latter polarized shew three parallel lines. Between two parallels the colour is a beautiful blue-white, the colour between the other two is dusky. Turning the polarizer the colours change place,—the dusky becoming blue, and the blue dusky. This seems to furnish a reply to my queries, and to refer the eruption at Jebogue Point to the *Paulo-post Triassic Period.*

3. Sunday Point Porphyrite.—A macroscopic examination

of this rock shows the existence of Biotite, Hornblende and crystals of a white feldspar. The polariscope shows the feldspar to be trichroic. The colours run in parallels, and the crystals shew beautiful striation.

4. Cranberry Point Diorite.—Macroscopically examined this rock shows abundance of Biotite and Hornblende. The Polariscope shews triclinic feldspar. This and the Porphyrite of Sandy Point seem to be closely related, but different from the Jebogue Point Dolerite. These two seem to be intrusive, but of a Lower Silurian age.

In considering the subject of the age of the gold-bearing rocks, it is evident that these crystalline rocks must be eliminated.

5. Yarmouth Harbour Rock.—This singular rock furnishes a very interesting section. It is composed of a glassy, undetermined mineral and hornblende. I have not been able to ascertain the nature of the former by the polariscope; portions of it seem to be a glass. One of the green hornblendic patches has a singularly pretty inclusion. In a small glassy area, bounded by two straight sides and two curved, is a perfectly round glassy inclusion. Turning the polarizer the inclusion darkens, until space and inclusion become altogether black.

Sections of other crystalline rocks are under examination. They will be the subjects of future notes.

Art. II.—Chebucto Nullipores, with Attaches.—By Prof. D. Honeyman, D. C. L., &c. *Curator of the Provincial Museum.*

(Read December 11, 1882.)

Our specimens appear to differ in their mode of growth. There is seemingly a vertical and a horizontal growth. Specimen No. 1 exhibits both. The upward growth developes into branches, the horizontal increases the body by layers, forming a *limestone*, having a concretionary and amorphous aspect.

Specimens Nos. 2 and 3 are amorphous. Of No. 1 the corallines encrust a stone. No. 2 and 3 are detached from their original support. Some of the tufts of the cespitose coralline have pits which have some resemblance to pores. Parts of the surface of the lamellar coralline have also numerous markings like pores. Still they are evidently nullipores.

Attaches 1 are specimens of *Algæ*, Rhodosperms. Cor. No. 2 has a large bunch of a beautiful *alga*.

This seems to be an article of food for fishes. I was familiar with it from the contents of fish stomachs before I met with it in its place of growth and was puzzled to ascertain its character.

Its name is *Ptilota Serrata.*

At. 2. In the recesses of the coralline tufts of specimen No. 1, are numerous foramenifera. In the bushy edge of specimen No. 2, are also specimens of the same foramenifer.

At. 3. On specimen 1 was a small *ophiura* star fish—Brittle Star.

At. 4. On specimen 1 are specimens of a species of Flustra.

At. 5. In specimen 2 are several *saxicava.* These have excavated their dwellings in the thick coralline,—No. 2 having entered betwen the base and the attachment.

At. 6. On all three are specimens of the pretty little gasteropod *chiton ruber.* There were many of these, more than can be now seen ; unfortunately the Museum mice examined the specimens, and appropriated several of the *chitons* and the little *ophiura.*

At. 7. Are two pretty little patellæ. One is whole, the other is crushed. The species is *Patelloida*, or *Lottia testudinalis.*

At. 8. Is another little patelloida. It is evidently a different species from *patelloida testudinalis.* It may be *patelloida alveus.*

There are also many little white subconical forms on the tufts of No. 1. I have not been able to ascertain their nature.

We have thus noticed : *Algae, Foramenifera, Ophiura, Polyzoa, Lamellibranchiata, Gasteropoda, Incertae sedis—7.*

There is another interesting nullipore to which I would direct attention. This, also, was dredged at the mouth of Halifax harbour. It is decidedly lamellar. Broken in two it shows a concretionary structure. On its surface is a considerable growth of the algæ *Ptilota serrata.* Branches of this lying on the coralline become imbedded by the calcareous growth. Some of these having been removed, have left indented impressions in the same way as ferns, &c., leave their impressions in Carboniferous shales. Other attaches are numerous foramenifera; many of these are lying in the *algæ.* Others on the coralline are sometimes partially imbedded and covered by the growth of the former. It is possible that parts of the *alga* and others of the foramenifera are enveloped in the coralline in the manner of fossils. No part of this coralline, although of considerable size, is cespitose. This seems to show that the cespitose corallines are distinct from the lamellar.

The under part is very striking. It is altogether separate from its original attachment, and seems to have been so for a considerable length of time. Several *saxicava* are imbedded, but all are dead. The valves of some have numerous small perforations. The operators, doubtless, succeeded in destroying the tenants.

Tubiculous annelids (worms) in great numbers adhere to the base and its cavities. The inmates have long gone.

The tubes are of serpulæ, of, apparently, two species. One species has a singular head, or ending, while the other is plain. The ending has the form of a head, the opening having the appearance of a circular mouth. This form is evidently not accidental, as several have it.

Other tubes are spiral. *Spirorbis* of apparently three species. Some of these are attached to *saxicava.*

Some of the hollows are lined with *sponges.* Among the tubes are numerous foramenifera. Other attaches are two or three pretty little *anomia.*

SUMMARY.

Algæ, coralline, foramenifera, sponges, serpulæ, spirorbis saxicava, anomia.

GEOLOGICAL.

One specimen seems to throw some light on the mode of formation of one of our Carboniferous Limestones. In the Pictou carboniferous formation there is a considerable variety of limestones. Of the manner in which most of these were formed, and their age, there can be little doubt. The internal and collateral evidence is sufficient to determine these points. One of these limestones, however, is exceptional. Its mode of formation is obscure,—internal evidence of origin is wanting, and the age is subject to question. This limestone is imbedded in the sandstones, or high ground, north of New Glasgow. My attention was first directed to it in 1862. Polished specimens were among the economic minerals of our department at the London Exhibition. It was considered to be a limestone, or marble, that might be adopted for ornamental purposes. It is brown in colour, and has a concentric structure. I took an early opportunity of examining the deposit, and of securing characteristic specimens. One of these, which is in the Museum, was polished by Mr. Wesley, marble worker, for the Paris Exposition of 1867. It was found that the bed was of limited extent, and that the sandstone with which it was united interfered with the polishing. Another of the specimens, cut vertically, shows a sandstone base. On this there is first a calcareo-siliceous layer, which is amorphous. On this another is formed with several centres, above this it is beautifully concentric. The top of the specimen is cauliflower shaped. When Sir W. E. Logan and Mr. Hartley surveyed the Pictou coal fields in 1869, the latter examined the limestone, but was equally unsuccessful with myself in finding fossils which could determine the age of the formation. He succeeded, however, in finding one form, a *spirorbis*. There was a large number of these attached to a specimen somewhat resembling our own. The appearance was so striking and singular that I will not readily forget it. I presume that the specimen is now in the collection of the Geological Museum, Ottawa.

There is, therefore, reason to suppose that the Hartley specimens and our nullipore are analogous, as both have concretionary lamellar structure and attached spirorbes, and that the carboniferous concretionary limestone is coralline or nullipore in origin.

ART. III.—NOTES ON SABLE ISLAND. By SIMON D. MACDONALD, F. G. S.

(Read March 12, 1883.)

IN bringing this Island and its surroundings to your notice this evening, I feel I am opening up a rich field for the future investigation of this Institute.

From its geographical position—midway between this coast and the gulf stream—it possesses characteristics peculiar to itself, and a phenomena so varied that there is work here for us all.

But not only does this Island invite our attention in the interests of science, but *demands* our attention in the interests of *humanity.*

Situated directly in the pathway of commerce,—enshrouded for weeks together by impenetrable fog—encircled by eddies and currents of the most erratic character—its dangerous and ever-shifting sand-bars, together with its terrible record of disasters, dating back from the earliest history of this country—it has earned for itself among mariners the well-merited appellation, that of " the grave-yard of North America."

And were we to-morrow to visit this island and witness its wreck-strewn shores—the ghastly grin of skeletons protruding from the embankment or lying awash on the beach—and listen to the sickening tales of the surf-men, we would feel guilty, indeed, if we, as members of one of the oldest scientific societies in this Dominion, did not put forth our greatest effort to learn something of the causes whose effects are so fraught with destruction, and give to the world the benefit of our researches.

While compiling the wreck-chart of Sable Island which we have before us, I have had to examine the early records of the Province, from which I have gleaned many facts in connection with the history of this Island. Having had the opportunity of visiting it on two occasions, and learning something of it as it is to-day, I thought it well to place the results before you, to form, as it were, a basis for further investigations.

The first notice of this Island in history, is from the voyage of John Cabot, who, in company with his son, Sebastian, sailed from Bristol in 1547, in a vessel called the "Matthew." After making the land at Labrador, he sailed south and westward, coasting Newfoundland and Nova Scotia, as far as Cape Sable. Finding here the coast trending suddenly to the *north*, and being short of *provisions*, with an *unknown* sea before him, he wisely turned his prow homeward. On the third day he passed two islands to starboard, which, from their *position*, must have been some of the higher hummocks of Sable Island. Viewed at a *distance*, these might easily be taken for separate islands.

Three years later an expedition, ordered by Emanuel, King of Portugal, followed in the wake of Cabot; but meeting with reverses, they returned, disheartened, to Lisbon.

Private enterprizes, however, stimulated by the glowing accounts given by Cabot of seas *blocked* with fish, were continued from year to year, and hundreds of Portuguese fishermen resorted to the banks.

To these people the credit is given of having placed cattle and swine on the Island for the benefit of those who might be cast upon its shores. That they were well acquainted with the place, there can be little doubt.

On a chart made by Pedro Reinel, as early as 1505, of Newfoundland and this coast, as far as *Maine*, this island is laid down as "*Sanda Crus.*"

In the museum of Paris is another chart, made by Gaftaldi (of New France), in 1550, showing the fishing banks extending from off Lahave to Newfoundland, on which this island appears as "Isolla del Arena."

In 1518, Baron de Lery made the first attempt to colonize this New France, but meeting with a succession of gales, which drove him back several times, he arrived on this coast too late to place his people under shelter before winter would overtake them, so he left part of his cattle at Canso, and sailed for Sable Island, where he placed the remainder, and returned to France. In after years these cattle had so multiplied that it became a matter of speculation for parties to land and hunt them for their hides and tallow.

The next mention made of this island is in the record of the disastrous voyage of Sir Humphrey Gilbert, who sailed from England with a fleet of five armed vessels. Arriving at St. John's, Nfld. —he found a large fleet of fishermen, of different nations—and took formal possession of the place in the name of Queen Elizabeth. The Portuguese treated him well, and after supplying him with wines, marmalade, sweet oil, &c., told him of their having placed swine and cattle on Sable Island. Thither Sir Humphrey sailed.

Several days after, during a thick fog, he lost his second in command on Sable Island. As this is the first wreck of which there is any history, written in quaint old English, I will read it as recorded :

"Sabla lieth, to the seaward of Cape Breton about 45°, whither we were determined to go, upon intelligence we had of a Portingall, during our abode in St. John's, who was also himself present when the Portingalls, about 30 years past, did put into the same Island both neat and swine to breed, which were since exceedingly multiplied.

"The distance between Cape Race and Cape Breton is 100 leagues, in which navigation we spent 8 days. Having the wind many times indifferent good, but could never obtain sight of any land, all that time, seeing we were hindered by the current. At last we fell into such flats and dangers, that hardly any of us escaped. Where nevertheless we lost our Admiral, with all the men and provisions.

"Contrary to the mind of the expert Master Cox, on Wednesday, 27th August, we bore up toward the land. Those in the doomed ship continually sounding trumpet and drums. Whilst strange voices from the deep scared the helmsman from his post on board the Frigate.

"Thursday, the 28th, the wind arose and blew vehemently from the south and east,—bringing withal rain and thick mist, that we could not see a cable length before us. And betimes we were run and foulded amongst flats and sands, amongt which we found flats and deeps every 3 or 4 ship's lengths. *Immediately* tokens were given to the admiral to cast about to seaward, *which* being the *greater* ship, and of burden 120 tons, was performost upon the beach. Keeping so ill a watch they knew not the danger before they felt the same too late to recover, for presently the Admiral struck aground, and had soon her stern and hinder parts beaten in pieces. The remaining two ships escapad by casting about E.S.E., bearing to the south for their lives, even in the wind's eye. Sounding on while 7 fathom, then 5, then again deeper. The sea going mightily and high."

In the wreck of the "Delight," or "Admiral," as she was called, upwards of 95 *perished*, 12 only *escaped*, and afterwards reached the Nova Scotia coast and were carried by some French vessel to England.

In 1598, the Marquis "De la Roche" obtained a charter from Henry III. to colonize and Christianize New France, and sailed in May of that year. Arriving off this coast, and fearing that his people,—consisting of 40 convicts from the French prisons—might escape, he landed them on Sable Island until he could make arrangements to settle on the main land. On returning he encountered a furious gale which, in 15 days, drove him on the French coast. He had scarcely *landed*, when he was thrown into prison by an enemy, and was prevented from communicating the result of his voyage to the king. Five years after, the king, receiving *intelligence*, ordered the pilot who had led them thither to proceed to Sable Island and learn their fate, which was found to be deplorable. Out of the forty landed five years previous, only twelve remained alive.

Finding themselves alone, and deserted, as they thought, by the very one whom they looked to for liberty and comfort, they became desperate. With no law to *restrain*, nor punishment to *fear*, each man's hand was turned against his fellow, and several had come to a violent end. The remainder, from ill-prepared food and exposure, became reduced in spirits, and had *lately* led more quiet lives. After being landed on the Island they managed to erect huts from the remains of a Spanish vessel wrecked in the breakers, and maintained existence by eating the raw flesh of the cattle Baron de Lery, or the Portuguese, had placed on the Island many years before, and which had become very numerous. In a short time their clothes were worn out, and they dressed themselves in the skins of seals.

On their arrival in France they were presented to the king. Their savage expression, unkempt hair and beards, which reached to their waists, together with their pitiful tale of want and *exposure*, so moved the *king* that he gave them fifty crowns a piece and permission to return to their homes. Strange to say, they afterwards sought passage to the island, where they accumulated a large quantity of fur.

In 1633, John Rose, of Boston, lost his vessel—the "Mary & Jane"—at this place. He was here three months constructing a yawl from the remains of his vessel, by which he reached the main land. His reports of having seen "more than 800 head of wild cattle, and a great many foxes, many of which were *black*," so interested the Acadians that 17 of them embarked in a vessel, taking Rose as pilot. After this Rose returned to New England, where the tidings of this wonderful Island soon spread. A company was soon formed at Boston to hunt on the Island. On their arrival they found that the 17 Frenchman who had wintered on the Island, had built houses and a fort, and so slaughtered the cattle that only 150 remained.

About 100 years *later*, a French clergyman named LeMercier, claiming to be an Englishman by naturalization, sent thither a number of cattle, previous to removing with his family. He had petitioned Governor Armstrong, at Annapolis, for a grant of the Island, but declining to pay a Quit rent to the government, the grant was withheld. A proclamation was issued forbidding persons from killing those animals, and they continued there for many years. At what period they were destroyed, and succeeded by the wild horses now upon it, is not known.

From this date up to the beginning of the present century, we have little information respecting this Island, except that it became a favourite resort of fishermen, for the purpose of hunting the walrus and seal.

With the increase of commerce, wrecks were more frequent, and it became the haunt of pirates and wreckers of the worst description, who are said to have lighted fires on the shore luring vessels to their destruction. Valuable jewels and rare articles having been exhibited as coming from there from time to time, strange stories of piracy and *murder* became frequent.

This, together with the report of several vessels being lost with all hands, in quick succession — among them being the "Princess Amelia," a transport having on board the household effects of the Duke of Kent and upwards of 200 officers and recruits, all of whom perished, although it was thought that many of them reached shore and were afterwards murdered by the pirates, excited the suspicions of the authorities.

The gun brig "Harriet" was dispatched, under Lieut. TORRENS, to investigate matters, when she, *too*, was lost. The government at once took action, and, by the advice of Sir JOHN WENTWORTH, an amount was appropriated for settling families on the Island to assist shipwrecked persons and for saving property.

A proclamation was issued, stating that persons found residing upon the Island without a license from the government would be removed and imprisoned for a period of not less than six years. This had the desired effect, driving off the wretches who infested it, and the present establishment was formed under the superintendence of one JAMES MORRIS in 1802.

Such is the early history which, though dim and fragmentary, yet serves to show that the Island was well known and frequented hundreds of years before the founding of Halifax, and that by a race of people who have left no descendants along our coast.

We will now consider the general features of this Island. It is simply an enormous accumulation of loose grey sand, forming two parallel ridges united at either extremity. It is crescent-shaped, with its inner side towards the coast.

The valley formed by these parallel ridges extends the length of the Island, 8 miles of which is occupied by a lake. A narrow ridge separates this lake from the ocean on the south, over which the sea breaks in many places during heavy weather.

According to the last admiralty survey, this Island is situated 85 miles from White Head, the nearest point on the Nova Scotia coast. The west end is in lat. 43, 56, N., and 60, 08, W. long.,—22 miles in length and 1 mile in breadth.

From a northern approach it presents the appearance of a succession of low, naked sand hummocks, some partially covered with vegetation. Beginning at the west end, those hills or hummocks have an elevation of about 20 feet, gradually rising eastward, attaining the height of about 80 feet in the vicinity of the east end light, beyond which they slope away until they meet the N. E. bar, which in fine weather dries for a distance of 4 miles from the grassy sand hills. About two miles from the beginning of this bar, an island is forming over an old wreck, and is covered with grass.

This dry bar is succeeded by 9 miles of heavy breakers, to a depth of 6 fathoms, 4 miles further with a heavy cross sea, with from 10 to 13 fathoms, and then ends abruptly, the depth increasing in a distance of 3 miles to 170 fathoms.

The N. W. bar dries about 1½ miles from the grass hills, with patches or shoals *nearly dry* one mile further out. Then 9 miles of heavy breakers in *fine weather*, succeeded by seven miles more in *heavy weather*, when the depth increases from five to ten fathoms, and where there is a great ripple and a heavy cross sea. The whole extent of this bar is 17 miles, beyond which the water gradually deepens.

Thus we have the Island, with its bars in bad weather, a continuous line of over 50 miles of foaming breakers, producing the most terrific effect; the Island seeming to shake to its foundation as the whole body of the Atlantic breaks upon it.

In addition to this bar, at either extremity there are three submerged bars, or ridges, parallel with the shore on both sides, with only a few feet of water, which form heavy breakers when there is any sea running, making it exceedingly hazardous for landing in boats.

On the south side the water deepens very *gradually*, thus extending its dangers far into the sea in *that* direction. Vessels seldom anchor on the south side, because of the prevalent swell from the south, and from the great distance from a landing, which is only practicable after a long continuance of northerly winds. While on the *north side* boats can only land during *southerly* wind and after a continuance of fine weather. But there are surf-boats belonging to the Island which can generally communicate when *ordinary* boats would swamp.

On the north side vessels anchor from one to two miles off shore. The bottom being fine sand, holds *well*, but the sea is so heavy, except in off-shore winds, that on the first indication of wind from the sea, a vessel must weigh anchor immediately and make an offing.

Wrecks on the N. W. or N. E. bar are of course far more dangerous to life than those that take place on the Island. In bad weather the rescue of a crew on the submerged portion of those bars would be impossible.

We have here a *chart* showing the wrecks that have taken place since the formation of the establishment by the Government, in 1802, for life-saving purposes, which I have compiled from official reports, and submitted to the three superintendents that have had charge of the Island. This chart shows the name and position of *known wrecks*. The unknown, on the bars, are, perhaps, far *more numerous*. After gales, and a long continuance of foggy weather, there are often sad evidences of disaster in the wreckage, and frequently bodies drifted on shore, of which nothing more is ever known. These bars, on the north side, are extremely steep, especially so the N. E. bar, having as much as 30 fathoms water close to it; hence a vessel caught here in a S. W. to S. E. gale, would probably strike, forge over and founder in deep water, leaving nothing whatever above to tell the tale.

In the immediate neighbourhood of the ocean little else but sand is seen, thrown up into every variety of drift, or scooped out by the wind into bowl-like hollows, relieved only by the stark timbers of many an unfortunate ship, washed by the waves or thrown high upon the shore, and the unceasing headlong plunge of the breakers, as each in turn rears its green head and breaks in a crest of foam as it rushes up the sloping beach. As we mount the hummocks and descend into the lake valley, the scene changes to that of a Western prairie. Desolate wastes of sand give place to green knolls and waving meadows of tall, luxuriant grass, interspersed with wild pea. In the vicinity of the lake can be gathered in their season *wild roses, lilies, asters, strawberries, blueberries, cranberries*—the latter affording quite a revenue to the Island.

Herds of wild ponies dot the valley and hill side. Here and there are fresh water ponds, girt with dense rank grass, where wild duck and water-fowl breed in thousands. Here, again is a long barren, known as the "desert," whose sands are as shifting as those of the Sahara, and equally as destitute of vegetation.

Thus alternate barrenness and vegetation, fertile valleys and sand hummocks, the entire length of the Island.

The Government establishment on this Island consists of a superintendent and 18 men, located at different parts of the Island. Besides the main station, there are five *out*-stations, where some of the staff reside. There are also two houses of *refuge*, in which are fire places filled with wood ; *match-boxes*, a *bucket*, and a *bag of biscuit*, hanging against the wall, out of reach of rats, which sometimes infest the Island. The door is simply latched. Written directions are posted up, showing the way to the stations, and how fresh water can be had by digging 18 inches in the sand. Many a crew, thrown on this desolate sand-bank in storm and darkness, finding their way to those houses, have had reason to bless the government for its thoughtfulness in providing for their emergency, without which many a poor fellow would have had to succumb.

At these out stations signal staffs are erected for the purpose of communicating with vessels or the *main* station, at which the row's nest on the cross-trees of the flag-staff has an elevation of 120 feet, and commands a view, in clear weather, of the entire Island.

During *fog* the island is patrolled once in 24 hours by roundsmen, or men from the outposts, on horseback.

Through the kindness of Miss DIX, who spent a short time on this Island, *four* Francis metallic life boats were placed at the different life-saving stations. There are also *surf-boats*, *rockets* and *mortars*, for throwing lines to wrecks, a *life-car* and *bretches buoy* for the landing of crews.

At the different stations there is a supply of tame horses always on hand to convey the boats to the vicinity of wrecks.

The life of the surf-men, though somewhat monotonous, is not an idle one. Each day has its duties. In fine weather their time is occupied in keeping the stations in repair, hauling firewood, attending to the domestic cattle, and farming in its season, besides landing supplies, and shipping wrecked materials on the visit of the Government steamer, and at stated times they have rocket and mortar drill, &c. In foggy weather, or after a storm, the watching of the beach for wrecks claims their whole attention.

Mounted on his pony the patrol wends his way, frequently in the teeth of the blast that almost sweeps him from his saddle, while often snow, hail and sleet—and oftener *still*, sharp sand drift, that cuts the face until smarting with pain—forces him to take shelter between the sand hills, and follow along the central valley, ever and anon mounting the hummocks to look seaward, and betimes plunging down into the land-wash to examine some object floating in the breakers — a spar, an empty bottle, or perhaps a hen-coop. Such tokens are often all he finds. And so he trudges on for miles. At length he discovers the next patrol approaching: they draw rein, exchange notes, *turn* and *retrace* their steps to report at head quarters. Thus patrols make the circuit of the Island.

The *horses* found wild here have been considered by Dr. GILPIN and others to resemble the wild horse of *Mexico*. It is generally thought that they were landed from some Spanish wreck. They are small, but *strong* and *active*, and show a power of endurance almost *surprising*; withstanding the inclemency of winter without other shelter than that afforded by the hillocks of sand.

The English *rabbit* has at different periods been very numerous, and threatened at one time to over-run the Island. But, to their *misfortune*, the Norway *rat* landed from an old vessel, and in a short time became so numerous that they nearly *annihilated* the rabbits, and then turned their attention to the stores of the Island, so that during *one* winter the staff were without bread for some months. In the spring the Government sent a detachment of cats to look after the *rats*. The *cats* killed the *rats* and then finished the remaining *rabbits*. In a short time the cats became so *wild* and *numerous* as to be a source of danger, when *dogs* were sent to hunt the cats, and with the assistance of shot guns in the hands of the staff, the cats were finally extirpated.

Again the Island was stocked with rabbits, when a *snowy owl* found his way thither, and being so delighted at his *find*, *disappeared*, and in a few days returned with his *friends*, who remained long after the rabbits were extinct, and still shows his kind remembrances by making periodical visits.

Until 1814, herds of wild *hogs* roamed the Island, which became *exceedingly fierce*, often attacking the cattle. But during a very severe winter all perished. Since that time this species of stock has not been allowed to range the Island, since, owing to their proclivity to hunt bodies in the sand, and devour those found in the land-wash, they became objects of horror and *disgust*.

The *walrus*, or *sea lion*, once repaired to this Island in large numbers. Their tusks are still being washed out of the sand, although they disappeared many years ago.

Early in January the Greenland seals make their appearance on the bars, for the purpose of *whelping*, and are sometimes hunted by the staff. The male is about 8 feet long, weighs often 800 lbs., and swims at the rate of seven miles an hour. They are very tenacious of life, often surviving the most severe wounds. Their habits are very interesting. When on shore they live in families, each male attended by several females.

The young at twenty days are nearly white, and those who have partaken of their flesh, pronounce it equal to that of sucking pig. When the males are old they are deserted by the females, and living apart from the rest, become exceedingly fierce. In their encounters they inflict on each other wounds like sabre thrusts, and after their engagements throw themselves into the sea to wash away the blood. The hunting of this species of seal is not without its dangers. They often turn upon their pursuers, and will sometimes ward off a blow, seize the club in their tusks and escape.

The common *harbour seal* is a constant dweller on the Island. In May their new-born whelps may be found sleeping on the sand in velvet coats, or riding the surges on their mothers' backs.

LIGHTS.

In 1873 the Government erected two powerful lights—one on each end of the Island—at a cost of $80,000, the propriety of which has been very much questioned.

Nearly every government that has come into power has had the subject of light houses on Sable Island before them, and as often has it been opposed by sea-faring men, who maintained that it would render navigation more dangerous than before. Their argument being that were no inducements offered to approach the Island, vessels would keep at a sufficiently safe distance from it; whereas, in the hope of making the light, they would be drawn near the bars, thereby increasing the risk and danger.

Some maintained, on the other hand, that if two powerful white lights were exhibited—one *fixed* the other *revolving*—they would be visible twenty miles, which would be quite far enough to warn vessels of their danger, and enable them to define their position. Mr. Howe, in his report of 1848, stated that although Capt. Darby and Mr. Cunard entertained the belief that a light would induce vessels to run for the Island, and lure them amid shoals and sand-bars, it was, in his opinion, strongly advisable that a light should be erected near the central station, and that vessels not bound for the Island, nor driven there by currents or stress of weather, would no more run for it than they do now,—that they would, in fact, keep clear of it, it having no harbour of refuge ; and that vessels outward bound would not require a new point of departure, while those homeward bound had all the coast before them ; and if made to revolve E. and W., it would show in which direction the bars lie, and to government vessels it would be of great service. But, as before, no further action beyond debating the matter took place—at that time.

Foremost among the dangers surrounding this Island is that arising from the irregularity of the marine currents that sweep its shores. To trace the origin of which let us turn our attention for a while to the course of the gulf stream and polar current.

By glancing at Maury's Physical Chart, it will be seen that the gulf stream, after discharging its heated waters through the channel formed by the coast of Florida on the one side and Cuba and the Bahamas on the other, follows the trend of the American coast northward until approaching the shoals of Nantucket, where it swerves to the N. E., passing south of Sable Island to the tail of the great bank of Newfoundland, and then stretching over to Europe in a due east direction.

In opposition to this, we have the cold, ice-laden current of the North, one portion of which, after leaving the Arctic ocean, passes southward along the eastern coast of Greenland, where being joined by another branch coming from Baffin's Bay and Davis' Straits, it passes along the coasts of Labrador and Newfoundland to the great banks, where it is met by the northern edge of the gulf stream. At this point a division of the polar current takes place,—one portion, from its greater density, sinks below the warm current of the gulf stream and continues its course southward as a sub-marine current. This has been doubted. In the Transactions of this Institute for 1865, is a letter from Admiral Milne to the President of this Society, concerning the currents on the N. E. coast of North America, in which he says : "This polar current passes along the east coast of Newfoundland as far as Cape Race, where a western part runs round it into St.

Mary's Bay, but the eastern part becomes lost. It is probably checked by the northern limit of the gulf stream, and turned into a more N. E. direction."

In that same year, however, it is recorded by CARPENTER, that while laying the Atlantic cable in lat. 51° N., and lon. 38° W., a heavy storm came down upon them, and they were obliged to cut the cable. A red buoy was attached to it by a long wire rope, which, however, soon after broke loose and drifted away. Seventy-six days after this buoy was seen by a West India mail steamer in Lat. 42° N., lon. 40°; having travelled due south 600 nautical miles, a rate of about eight miles a day, directly against the gulf stream and prevalent winds, which can be only accounted for by the fact of the great length of wire rope that was hanging in the deeper polar current.

This has been further demonstrated by deeply-submerged icebergs being carried into and *across* the gulf stream, and being seen repeatedly as far south as 36° lat., by which it is inferred that the deeply-immersed portion offered more resistance to the lower current than to the shallow surface current, and was thus borne southward *across* the gulf stream.

The other portion of the polar current, when it impinges on the gulf stream at the great bank, becomes deflected to the westward, partially by contact with the great bank, and in its course its northern edge sweeps around Cape Race, into St. Mary's and the other bays north, until losing momentum it falls back and joins the main body of the current. This portion, sweeping around and into those bays, is commonly called the indraught by mariners, and to it, being accelerated by certain storms, is attributed the loss of the "Cedar Grove," at Canso, and the Cromwell boats at Cape Race.

The southern edge interlaces the gulf stream, and carries western bound vessels at such a rate as frequently leads mariners to miscalculate their position with reference to this island; to which fact are attributable many of the wrecks.

Capt. DARBY, a former superintendent of the Island, in a letter to Blunt's Coast Pilot, with regard to the strength of this polar current says: "The most of the wrecks occurring here arise from error in longitude. I have known vessels from Europe that had not made an error of one-half degree in their longitude until they came to the banks of Newfoundland, and from there in moderate weather and light winds have made errors from 60 to 100 miles." It is difficult to understand how that commanders of vessels, making voyages to and from this country for so many years, should be apparently so ignorant of the strength of these currents, unless, as it would seem, they have periods of comparative quiescence and activity.

Then, again, we have a third current—a portion of the polar current, which, becoming detached at the southern end of Labrador, and sweeping through the Straits of Belle Isle, is joined by the vast flow of the St. Lawrence, and forms what is known as the Gulf of St. Lawrence current. This combined current skirts the east side of Cape Breton, passes south, and strikes obliquely in the vicinity of Sable Island that portion of the polar current which is deflected westward by contact with the banks of Newfoundland.

To these opposing currents, then, must be attributed those dangerous marine disturbances off our coast, of which Sable Island seems to be the centre. Capt. CLOUE, of the French navy, remarked that during his survey of the Quero bank, adjoining that of Sable Island, nothing surprised him more than the strength and uncertainty of the currents, which often set in a contrary direction to the prevailing winds, and change all round the compass in 24 hours.

This, of course, is in accordance with well-known law. Currents of water, like currents of air, meeting in opposite directions, produce eddies and swirls of the most conflicting character.

In February, 1803, the first superintendent, having had three months of anxiety from the rapidity with which the Island had washed away in the vicinity of his house, and having lost much of his provisions from the depredations of rats, and fearing that *want* would stare him in the face before relief would reach him in the spring vessel, built a dispatch boat and sent her out crowded with sail before a S. E. gale, in hopes that she would reach the main land, or be picked up by some inbound vessel that would carry the dispatches to the Government, and acquaint them of the starving condition of those on the Island. To his surprise, in 13 days *after* she returned to the beach, six miles above where she set out from.

This swirl motion around this Island is very marked. In calm weather an empty barrel or cask will make circuit after circuit of the Island, and this experiment is often resorted to for testing the velocity of the current. Again, bodies from wrecks have often made the same circuit, and it is quite customary for the surfmen to search on the opposite side for things which in consequence of an off-shore wind, have been carried thither by the current, and deposited upon the beach. During the prevalence of stormy weather these currents become terribly conflicting, and if accompanied by high tides, often remove by their eroding action, hundreds of feet from the embankments Then again, danger often arises from the lowness of the shores.

Being *treeless*—with the exception of the light houses having nothing to distinguish it from the surrounding ocean which it so resembles in colour—vessels have been known in a stiff breeze and clear weather to run *directly* for the Island without the slightest knowledge of its proximity, until their attention has been arrested by the red ensign flung to the breeze from the flagstaff at one of the stations. Often sailing vessels and mail steamers are seen from the Island in positions clearly showing that they were unaware of its presence.

Fogs of a density seldom experienced elsewhere are prevalent all the year round, and accompany all winds from N. E. round by south to S. W. The warm, moist air from above the gulf stream meeting the cold air above the polar current, is condensed into fog which gives but little warning of approach, and contributes in a marked degree to the dangerous surroundings of this Island.

Another danger arises from its proximity to the gulf stream. Ask the mariner where he most dreads to encounter the storm, and perchance he will answer on a lea shore or the northern edge of the gulf.

MAURY, who made a life study of the stream, says: "With such elements of atmospheric disturbances on its bosom, it follows that storms of the most violent character would accompany it in its course. Accordingly the most terrific that rage on the ocean have been known to spend their fury on its northern border."

There have been some memorable tempests here which have marked, as it were, *periods* in the history of this Island,—nights of terror never to be forgotten. The inhabitants of this lonely, desolate sand-bar have often despaired of ever seeing the dawn, and sat speechless for hours, listening, terror-stricken, to the howling of the blast, which threatened every moment to hurl their dwellings from their unstable foundation into the seething ocean. On one occasion, on going forth after such a night, they were horrified to find that, in addition to the transformation undergone around them by the removal of sand-hills, and the creation of others, that a portion equal to 3 miles long, 40 feet wide, and from 20 to 60 feet high, had gone bodily from the north side of their Island. This now forms one of those parallel bars over which the sea in storms breaks in terrific tumult. The awful violence, as well as the suddenness of those storms, which are cyclonic in their character, form one of the most remarkable phenomena of this Island..

The sun often rises clear, giving indications of continued good weather, and, with the exception of the sea breaking high on the bars, and the fretful moan of the surf as it breaks along the shore, there is no premonition of the coming storm. Suddenly a dull, leaden haze obscures the sun: clouds gather from all directions. The sky assumes a wild, unusual appearance. The wind begins to rise in fitful gusts, carrying swirls of sand before it. The darkness increases as the low, driving scud shuts in all distant objects. Now the gale bursts in awful fury, whipping off the summits of the hummocks, carrying before it a cloud of blinding sand-drift. Darkness adds to the horror of the scene, while rain descends in a perfect deluge. No human voice can be heard above the tempest. The crinkled lightning for an instant lights up the mad waves, as they rear and hiss along the beach. Then a sudden calm ensues,—as strange as calm. A few short gusts at first break this period of tranquility, and in a few minutes the hurricane bursts again from the opposite quarter. The darkness is still intense, relieved only by the red glare of the lightning, which is quickly followed by the crashing of the thunder, as it strives to be heard above the howling of the blast. Gradually the storm ceases, the clouds break and pack away in dense black masses to leeward, and the sea alone retains its wild tumult.

During such a tempest in 1811, thousands of tons of sand were carried from the beach—some from one side and some from the other, as the gale shifted—and strewn over the island, so that vegetation was nearly smothered, hundreds of horses died for want of food, and the outlines of the Island completely changed. Sand-hills that had formed land-marks were tumbled into the sea, and mountains piled where once were valleys; recent wrecks disappeared, and others brought to view of which there is no history.

It is interesting to note that while in several places in Great Britain they are at present making many and successful experiments in the way of lessening the dangers of harbour approach by pouring oil on the troubled waters, the utility of this has been demonstrated at this Island nearly 40 years ago, and although the superintendent, Capt. DARBY, gave every publicity to the circumstances, and pointed out its advantages, we have little evidence of it being adopted until the last few years.

As this oil theory is attracting so much attention of late, in Liverpool and other places, I will give you, in a condensed form, Capt. DARBY'S report of the saving of Capt. HIGGINS and his crew, as follows:

"On the 19th of September, 1846, the Government schr. "Daring," commanded by my eldest son, came to the Island for the purpose of conveying to Halifax the crew and materials of the wreck of the ship "Detroit," lately stranded there with her crew and passengers; also the crew of the schooner "Lady Elcho," lately stranded there. We got the schooner down the north side to the wreck of "Detroit," about ten miles to the eastward of head-quarters, and commenced shipping her materials, and the work went on with vigour and alacrity. The day was moderate, with light airs of wind from the eastward. It was a clear and cloudless day, but it had a certain dull appearance about it, that seemed to portend a gathering of the elements together, as if for strife. The sea ran high, although there was no wind, and gave us a good deal of trouble, by often filling our loaded boats in crossing the bars, where it often broke very badly, and rolled along the shore with a groaning and very troubled sound. After the sun passed the meridian the gloom and dulness seemed to increase, the sea rose higher, although but little wind, and the moaning sound of the waters as they broke along the strand, seemed to give strong indications of a coming storm. Our work proceeded successfully, notwithstanding the difficulties we had to contend with ;—the property was all shipped, the vessel loaded and ready for sea, and at half an hour after sunset she got under weigh, with our boat and boat's crew to be towed up to head-quarters and landed there. The wind was now a fresh breeze from east. I got on my horse to keep abreast of the vessel, which I did until dark. I had ten miles to go to the landing place, I drove to that point as fast as I could, and then rushed on to the beach to watch the arrival of my boat. It was now very dark, with a fresh breeze, and the sea rising very fast. The whole ocean seemed to be in a phosphoretic blaze of light. I soon observed our boat coming directly towards me: I jumped off my horse, and as I always rode with six fathoms of line on my horse's neck, one end I fastened there, and the other end I tied to my leg. I was then able to assist my people in the boat without loosing my horse, as she filled and turned over just as she got within my reach. The people reported that the schooner hauled off to sea the moment that the boat left her. We hauled up and secured our boat for an approaching gale, then went to the house, changed our wet clothes, got supper, and set a watch. At midnight the watch reported heavy gale of wind from E. N. E.; at four o'clock the morning of the 20th, a most terrific gale of wind with rain from the N. E.; and at daylight the gale to be still increasing, and the wind veering to the N. N.E. All hands out. The hull of the schooner *Lady Elcho*, that had been wrecked near the landing, could be seen from the look-out house to be floating and knocking about on the beach, and we had to crawl on our hands and knees across the Island to where her cargo of barrels of mackerel was piled up,—the wind being so violent we could not proceed against it in an upright position. We found the cargo in danger of being smashed to pieces by the sea, and we commenced parbuckling it up the bank to a place of comparative safety, and were so occupied until about noon; and it was this circumstance that brought us all out there in that terrific gale, as if Providence directed that we should all be out and all together so as to be the better prepared for what was going to follow. All of a sudden, we saw an object off the North side dead to windward which we first thought was a large bird, but shortly after discovered that it was a sail distant five or six miles, and that she was running down right before this tremendous gale dead on a lee-shore. We could work no more at the barrels. Our eyes were strained in the direction of the object that appeared to be running to inevitable destruction. My first impression was that it was the schooner *Daring* which had left the Island the evening before, and that they had met with some disaster so as to disable the vessel in the gale, and were going to run her on shore before night to save their lives.

We could see that she was a schooner with a close-reefed mainsail set, steering directly for our flag-staff. I was convinced that it was my son, who with two of his sisters on board, and a great number of other passengers, were taking this method to preserve their lives. The sea was breaking everywhere off the North side as far as the eye could see, and it appeared almost incredible that any vessel could live to come so great a distance through such mountains of broken water. I got a rope prepared, to assist in preserving the people's lives should the vessel be able to reach the beach through the roaring and boiling mountains of water that surrounded her. When she approached within three miles of the land she appeared to be in the heaviest breakers, and we could plainly perceive mountain waves on each side of her that would raise their curled heads as high as the tops of her masts and pitch over and fall with the weight of hundreds of tons, either of which would have been sufficient to have smashed that frail bark to atoms; but, miraculous as it may appear, not one of them touched her. At one moment you could just perceive the heads of her masts between the mountains of waters that were smashing and breaking to pieces all around, but not permitted to hurt her; at the next moment you would see her on the top of a tremendous wave which appeared like certain destruction to her; at another, you would see a mountain sea rising up before her and breaking all to fragments in her path, but when she arrived at the spot the surface was smooth as glass. When she arrived within one mile of the shore she had to pass over what we call the Outer Bar, where every sea broke from the bottom, and our greatest anxiety for the safety of the vessel was at this point. The sea was there breaking with tremendous violence, but that heaven-favored bark passed through untouched,—the sea became smooth before her, and she left a shining track behind. Now, here was the miracle. I looked on this with wonder, awe and admiration, and not without hope. When she approached a little nearer, I could see one man lashed to the helm and two men forward lashed by each of the fore-shrouds, and by each man a large cask standing on end. We could also see that the two men were making great exertions with their arms, as if throwing something up in the wind. The vessel had now passed the most dangerous place, and her safety seemed certain,—I could breathe much freer than I had done for some minutes. Another half-mile brought her to the beach, and her bow struck the sand. From this spot to the high bank was about fifty or sixty yards over a flat beach, which was always dry except in heavy gales, but was now covered over with water. A number of heavy seas would roll together over the beach, and then recede, leaving it dry. Over this place myself and the men were extended with a rope leading from the bank down to the vessel's bow, on which we held to keep the sea from washing us away; and when the great body of water receded, we could approach as near as the jib-boom end, from which, one by one, the crew lowered themselves by a rope into our arms, and we passed them in safety to the bank.

"The Schooner was the *Arno*, Capt. HIGGINS, with twelve men, from Quero Bank, where they had been fishing. They left the Bank at the commencement of the gale. He had lost all his head sails when at daylight this morning he made the land dead under his lee, with the gale blowing right on shore. The vessel having no head-sail, he could do nothing with her on a wind. He let go his anchor in twenty fathoms of water, paid out three hundred fathoms of hemp cable, and brought the vessel head to wind. In that tremendous sea he held on until noon, when, seeing no prospect of the gale abating, he cut his cable and put the vessel before the wind, preferring to run her on shore before night to riding there and foundering at her anchor. He lashed himself to the helm, sent all his men below but two, and nailed up the cabin-doors. He had two large casks placed near the fore-shrouds and lashed there. He then directed his two best men to station themselves there and lash themselves firmly to the casks, which were partly filled with blubber and oil from the fish. They had each a wooden ladle about two feet long, and with those ladles they dipped up the blubber and oil, and threw it up in the air as high as they could. The great violence of the wind carried it far to leeward, and, spreading over the water, made its surface smooth before her and left a shining path behind; and although the sea would rise very high, yet the top of it was smooth, and never broke where the oil was. It was raging, pitching and breaking close to her on each side, but not a barrel of water fell upon her deck the whole distance. The vessel was so old and tender that she went all to pieces in a very short time after the crew, with their clothing and provisions, were saved."

With regard to this phospheresence of the sea, at times there are magnificent displays of it here. Among the early inhabitants it was the cause of much alarm, and augmented the many stories of the supernatural told in connection with the place. Its first appearance to one of the superintendents, is recorded in the journals of the Island as follows:

"Last night a singular phenomenon appeared on the south side. The sea being high, and the night very dark, the breaking of the sea would exhibit at intervals of from 5 to 10 minutes a phosphorescent light. In some places it would be seen through the gulches on the south side. When the beach was low, and the sea broke high, it would rise in a great bright light to the height of 15 or 20 feet, like an enormous fire, yet only to be seen at certain places at a time."

In other places it is spoken of as the sea being on fire.

It generally appears after much southerly wind, and is probably brought by the drift, or surface current, from the Gulf Stream.

In the short time allotted me this evening, Mr. PRESIDENT, I can but glance at the many interesting phenomena of the Island and its surroundings. These facts and incidences are such as I have been able to obtain from available documents, as well as from personal observation. From these facts I have deduced certain inferences, the plausibility of which I humbly submit to the judgment of the Institute.

On some future occasion I hope to present to you in detail what is, perhaps, the most interesting and important feature in connection with this Island, viz.—ITS CHANGED POSITION.

ART. IV.—GLACIAL TRANSPORTATION IN NOVA SCOTIA AND BEYOND.—*(Problem of 1873 solved.)* BY PROF. D. HONEYMAN, D. C. L., &c. *Hon. Member of the Geol. Assoc., London.*

(Read Feb. 12, 1883.)

[*Substance of this and of preceding Paper on the same subject, communicated to the Geologists Association of London at July meeting.*]

PICTOU COUNTY.

LAST summer I extended my observations from West River railway station, eastward as far as the Albion mines. Syenitic boulders were observed on both sides of the railway, as far as Hopewell station. At the new workings of the Albion mines I collected boulders from the drift—syenitic gneisses and syenites. The position of the drift having these boulders is intermediate between the Cobequid mountains and the Archæan rocks of East River. The source of the boulders is therefore problematical. They may have been brought to their present position by floods occurring at the close of the glacial period. One of the boulders is a very beautiful syenite. I found a large boulder of a similar character near Merigomish harbour in 1868. It was composed of white and pale red orthoclase, light green hornblende and hyaline quartz. I have not seen a syenite like it *in situ*.

ANTIGONISH COUNTY.

On the shore at Morristown, (Antigonish) boulders, large and small, of Diorite of strongly-marked character, attracted my attention upwards of twenty years ago. Much speculation was indulged in regarding their source. It was concluded that they had been transported from the Labrador coast.

When I discovered the typical "Archæan" Arisaig rocks on Northumberland Strait shore in 1868, I was pleased to find a rock precisely similar to the boulders in question as one of the rocks of the series. I may remark that in all my examinations subsequently of the Archæan rocks of Nova Scotia and Cape Breton, or elsewhere, I have not found another rock like it. On re-examining the shore where the boulders lay, I observed similar boulders rolling down the bank out of the drift which overlies the gypsums and limestones. I consequently concluded that the boulders had been derived from the Archæan rock on Northumberland Strait,—having been transported a distance of 10 miles. A line drawn on the Admiralty Chart from the position of the rock to that of the boulders on the shore, runs S. 20 E., N. 20 W., magnetic. This is parallel to the line of Blomidon amygdaloid transportation. This is a striking coincidence. It is also parallel to the intermediate glacial lines of Gay's River road and the Gore. *(Acadian Geology Table.)*

Further west in the Arisaig Township, we have the jaspideous rocks of Frenchman's Barn and of Arisaig Pier, transported southwardly; massive boulders being found landed on the higher grounds.

ADMIRALTY CHART LINES.

My working chart shows the Strait of Canseau running parallel with the extension of the Northumberland Strait and Morristown (Antigonish) Archæan transportation course, and all the Atlantic coast harbours of Nova Scotia, as far west as Ship harbour, approximately parallel. From Ship harbour to Halifax harbour the harbours follow approximately the course of lines made by local glaciers. *(See preceding Papers. Trans. 1875-6, and 1881. S. and E.)*

Halifax harbour and the estuary of the Avon are in the line of the Blomidon and Halifax glacier, which has transported the triassic amygdaloids. The Archæan transportation glacier converging on Bedford Basin. The Blomidon glaciation lines extended N. W., pass through the depression of the Cobequid mountains.

ANNAPOLIS COUNTY.

As I have noticed in other papers on general geology, triassic amygdaloids, from North Mountain, a continuation of Blomidon, were collected by myself in the drift cuttings of the

Nictaux and Atlantic Railway, on the S. E. side of Cleveland mountain, a part of which is called South mountain, on the south side of the Annapolis Valley. Near the front of Cleveland mountain (N.), an interesting exposure of glaciated argillites occurs where the old or steep road meets the new one. This position is nearly on a level with the general elevation of North mountain. This is the only striation that I have noticed on the north side of Nova Scotia. I remarked of this striation that the agent making it and transporting the amygdaloids from the North mountain, must have had a highway across the tract intervening between the two mountain ranges. I therefore inferred the *non-existence* of the Annapolis Valley in the glacial period.

I also noticed at Nictaux a transportation of granite northwards, from the granites of South mountain towards the Annapolis Valley. I have considered the amygdaloid transportation as during the glacial period, and the granite as occurring towards its close during the formation of the Annapolis Valley, the granite having been transported by land-slips or avalanches.

KING'S COUNTY.

In the middle of the Annapolis valley, near the Berwick station of the Windsor and Annapolis Railway, numerous boulders of granite were found. These, too, have been transported northerly from the granite region of South mountain. The time of transportation, and the agency, may possibly have been the same as referred to in the preceding case.

At Kentville, trappean boulders from the North Mountain were observed, and a beautiful specimen of fortification agate collected.

On the south side of Wolfville—on the side of the road that passes Acadia College—abundance of amygdaloids and other trappean boulders were observed. At the south-east they were very abundant, near, and in the Gaspereaux Valley. The size and number of these were such as might be expected in sight of Blomidon, and without any apparent obstruction in the path of transportation. I was disappointed, however, in observing their rarity in the space intervening between Wolfville and Blomidon. I do not recollect of seeing any trappean boulders until approaching the latter. I found on Blomidon the amygdaloid rocks,—the source of supply—far from exhausted by the enormous levy that had been made to supply so liberally the drift between Wolfville and the Atlantic.

I noticed, also, another great granite transportation. Granite boulders were first observed in Halfway River, at the line between the Counties of King's and Hants. Approaching their source, the extension of the granites of South mountain, already referred to, the size and number of the boulders was so great as to lead to the belief that the solid granite was underneath, while the underlying rocks were found to be argillites. The transportation is like the cases already referred to northerly. Amygdaloids of the southerly transportation were also observed among the granite boulders among the argillites of Greenfield.

HANTS COUNTY.

On the estuary of the Avon, from Horton Bluff to Windsor, amygdaloids are seen in great abundance, and often of considerable size. Besides the lower carboniferous limestones, above the old Avon bridge are abundance of small amygdaloid boulders. It was when examining these limestones, and collecting their fossils, in 1861, that I first noticed the amygdaloid boulders. Prof. How then informed me that they were from Blomidon. On every subsequent visit to this locality, I made a more intimate acquaintance with them and their minerals. It was this acquaintance that led me to recognize their fellows at Cow Bay and elsewhere.

BEYOND.

While some of the movements were undoubtedly local, others —*e. g.*, the Archæan transportation of Antigonish—could not possibly originate on the border of Northumberland Strait. This conviction left me to consult the record of observations made in Canada by Sir Wm. E. Logan and others, in the table of glaciation grooves in "Geology of Canada, 1863." Pp. 890, 1–2. Here I found Nova Scotian courses S. E. prevailing over S. W., up to

Lon. 80° 54, in the ratio of 2·1. This convinced me that the Nova Scotia courses were part of a system having their beginning in the distant N. W. To illustrate the relation of these to the general transportation of Nova Scotia, S. E., I added a sheet to my chart, so as to be able to locate the groove lines of the table as far as Lon. 38° W. The illustration is very striking. The variations from the S. E. course are probably like those of Nova Scotia,—deviations arising from local causes.

About the 80° meridian the arrangement of glacial lines is peculiarly striking. Here we have a point of general divergence. West of this the glaciation has a S. W. course, S. E. lines being the exception.

Lake Temiscamang has 10 localities with S. E. striation. East Bay of this lake, Lon. 79° 30, seems to be about the point of divergence. Here the striation has a course S. 53° E. Beyond the lake the courses are S. W. This is one of the lakes of Ottawa river. The sources of the river lie to the north of it, nearer Hudson's Bay. Lake Nepissing, S. E. Bay, Lon. 79° 33 has striation course S. 35° W., and a westerly water course, so that the point of glacial divergence seems to be also that of water.

Last summer I had repeated opportunities of making a *reconnaissance* of the superficial and other geology of the region traversed by the Intercolonial Railway as far as Point Levis. I observed frequently boulders which doubtless were transported from the Archæan region north of the River St. Lawrence.

OTTAWA.

At Ottawa I made a closer examination of Archæan transportation when making acquaintance with the geology of the district. On the Rideau river, at the shooting range, I examined the large boulders lying around. The majority of these were gneisses, and foreign to Trenton limestone and Utica slate of the district. There were boulders of syenite, diorite, granite and syenitic gneisses. One syenitic gneiss boulder was replete with magnetite. Of these I secured Museum specimens. In Sir W. E. LOGAN'S table, there is reported striation at Barrack-hill, having a course S. 45° E., and at Rideau river, Stegman's rapids, S. 45° E. I located and extended this striation course on VENNOR'S map, and found it to run between the Hull and LAYCOCK'S Iron Mines, situate in the Laurentian (Archæan) range to the north of Ottawa, where we might expect magnetite to exist in gneisses. In the same table there is striation noted at Hull, having also a course S. 45° E.

KINGSTON.

I had also an opportunity of making a *reconnaissance* of the Geology of Canada between Montreal and Kingston,* and between Kingston and Ottawa. The Archæan, near Kingston, with the Trenton limestone directly overlying it, was a point of special interest observed. When preparing the Nova Scotia department at the Dominion exhibition, I observed numerous and massive Archæan boulders on and around the exhibition grounds. These very much resembled the Ottawa boulders, being granitic and syenitic gneisses, syenites, &c., transported from the Archæan region on the north. Specimens of these were also collected for the Museum. Among the boulders was a piece of Trenton limestone, beautifully glaciated. Of this I also secured a specimen. In my search for glaciation, I observed Trenton limestone, deeply furrowed, near the entrance to the Royal Military College. The course of the furrows was found to be S. 45° W. In Sir W. E. LOGAN'S table there is Kingston lat. 44° 14′, lon. 76° 29′. Direction of grooves S. 45° W., other grooves S. 85° E. I observed the phenomena of glacial transportation to a distance of 3° short of the longitude of Lake Temiscamang. The longitude of Archæan transportation of Antigonish being 61° 53′; the field which I here traversed and found boulders by Archæan transportation is 14° 36′ from east to west. The great transportation lines of Nova Scotia extending N. W., reach Hudson's Bay at James' Bay, on the east side.

In my investigations I have thus added to the region of Canadian observers the Province of Nova Scotia, and given the great south-eastern transportation of North America an Atlantic terminus.

BOULDERS.

On New Year's day, Mr. NOLAN, whose name has already been mentioned in connection with Observatory Hill, H. M. Dockyard, showed me a boulder broken into four pieces, as something interesting. The boulder is of triassic amygdaloid. Its colour is gray, its amygdals are numerous; their minerals are heulandite and stilbite. It is altogether a striking specimen. The piece in my possession weighs 12¾ lbs. The weight of the whole seems to have been about 25 lbs. It has been an associate of Observatory Hill amygdaloid boulders referred to in a preceding paper. Its character is unmistakable. The North Mountain, Blomidon and Five Island rocks are the only series in British America that could produce it. The striation in the vicinity of the Dockyard points to Blomidon as the locality whence it came, I have already referred to rocks of Blomidon as similar to our boulder. I have no hesitation in affirming that this boulder and its associates have travelled over-land from Blomidon, a distance of 64 miles. While I believe this, I can excuse the incredulity of those who are not educated to appreciate the convincing nature of the evidence upon which my faith is founded. As I survey the present appearance of the way over which our boulder has travelled, its transit appears to be an evident impossibility. To prepare a way for its passage, we assume that there are heights, hollows and dead level, where in pre-glacial times there was necessary altitudes and more or less incline. To restore this state of things I made two postulates: 1st. That all the boulders and rock detritus which were carried from their original position and cast into the Atlantic, or scattered broadcast as we have found them over the length and breadth of the Province, should be restored to their pre-glacial position. 2nd. That the action of post glacial agencies should be annulled. We can then see in the visions of the past a great highway over which special agencies of speculative character advance, it may be slowly but surely, and irresistibly in a S. E. direction, accumulating freight in their progress and discharging it into the Atlantic. Then in process of time the same agencies are seen in their alternate retreat, advance and retreat, unloading their freight, raising drift accumulations, and obstructing or destroying the great highway so as to render it impossible for any like agency to accomplish similar work. This is the condition in which we now find it, unless where the condition has been aggravated by the operations of agencies at work in post glacial times.

HISTORY OF THE PROBLEM.

In the summer of 1872, Judge (in Equity) JAMES showed me, in the Museum, a beautiful specimen of agate, which he found at Cow Bay. I recognized it at once as an agate from the Blomidon series of rocks, and said so. I thought no more about it. On the 24th of May the following year—the Queen's birthday—I went to Cow Bay with my late lamented friend—W. S. STIRLING, Esq., of Halifax, to spend a holiday. Wandering along the shore, my attention was attracted to the amygdaloid boulders washed by the sea. I recognized them as Blomidon rocks. Their occurrence here was perplexing, until abundance of like boulders and a beautiful specimen of agate, were seen and collected out of the lofty section of drift on the east side of the bay. Masses of quartzite, curiously furrowed, also fallen from the drift, suggested a connection with the striation of Point Pleasant. An interesting problem in glacial transportation thus presented itself for solution. I forthwith commenced investigations. I communicated two papers to the Institute containing the results of these investigations. One was read in December, 1875, and the other in March, 1876. At the request of my friend, Prof. LESLEY, the substance of these was communicated to the American Philosophical Society in May 16, 1876. The Paper was illustrated by a sketch map, and an extensive suit of boulders, derived from the various formations over which the transporting agent had passed. This collection, of which there is a list in my paper read to the Institute "On Nova Scotian Geology at the Centennial Exhibition of Philadelphia, 1876," was awarded a prize medal by the International Judges of Class I. Further investigations were recorded in my paper "On the

Geology of King's County." *Trans.* 1877–8. In my paper "On the Superficial Geology of Halifax and Colchester Counties," read last session, I recorded other investigations. In the present paper is a record of the last steps which I consider necessary for the solution of the problem. By going *beyond* Nova Scotia, I have done more than I expected to accomplish.

ART. V.—AN ANALYSIS OF A PICTOU COAL SEAM. By EDWIN GILPIN, JR., A.M., F.G.S., M.R.S.C. *Inspector of Mines.*

(Read April 9, 1883.)

THROUGH the courtesy of Mr. H. A. BUDDEN, Vice-President of the Intercolonial Coal Mining Company, I am permitted to lay before you the following analysis of a seam of coal, recently opened by them at Westville, Pictou County. Through the kindness of Mr. ROBERT SIMPSON, General Manager of the Company, who furnished me with a complete column of the seam, I was enabled to make a very careful and exact measurement of the various layers comprising the seam.

The following is the section of the seam in inches and tenths of an inch, beginning at the top:—

	INCHES.	INCHES.
Coal, coarse and shaley	....	5·4
" good, with two thin layers of shale, each 1-20th of an inch thick	4·4	....
" good, but coarse	6·7	....
Shale	....	·2
"	....	1·7
Coal, good	6·3	....
" shaley, with nodules of iron pyrites.	·5	....
" good, with four bands of shale, up to one-half inch thick	1.4	....
Shale	....	·6

	INCHES	INCHES.
Coal, with bands of shale	....	·9
" good	4·7	....
" coarse and shaley	·8	....
" coarse	·8	....
" good	2.8	....
" " with several fine layers of shale	1·2	....
" "	5·6	....
Shale, with films of calcspar	....	.2
Coal, good	4·8	....
" with layers of shale	....	.9
" coarse with nodules of iron pyrites.	....	2·8
" good, with films of calcspar	4·0	....
" with layers of shale	....	1·8
Shale	....	·1
Coal, good	6·0	....
" shaley, with films of calcspar	....	3·0
" coarse, with spirorbis, etc	....	1·0
" shaley	....	·2
" good	9 8	....
" coarse, a few layers of shale	2·0	....
" good	2·0	....
" good, with films of calcspar, and a few nodules of iron pyrites	7·1	....
Shale	....	·1
Coal, good	13·2	....
" " with layers of shale	.2	....
" " with a few nodules of iron pyrites	13·0	....
TOTAL............*Coal*	97·3 *Shale*	19·0

This succession of layers presents some points of interest on which I would say a few words.

In no point do coal seams differ more than in the number and size of the included layers of shale. The Vale seam, in Pictou County, presents, at numerous points through the mine, a section in which no bands of shale can be detected. Other seams contain them in varying proportions, sometimes to such an extent that the coal is rendered valueless for economic purposes. Almost the only value these bands of shale possess, is their record of the progress of growth of the associated coal. Applying the record of the numerous small bands of shale and shaley coal found in the seam under consideration, we learn that the growth of this deposit was not an uninterrupted one. Scarcely had the vegetation for a few inches of coal been accumulated, when a change took place, and it was covered by a layer of mud.

It is useless, perhaps, now to speculate how this covering was formed, perchance the shelter of some bar was broken, and for a season the tides could deposit their burden, or some nameless river of bygone days became obstructed and flooded the swamps, in which grew the weird vegetation of the carboniferous era.

Then, again, the vegetation accumulated to be once more interrupted. The presence of layers of coarse and shaley coal shows that the transition from a flourishing vegetation to a mud-laden flat was, in some cases, a gradual one, due, perhaps, to periodic inundations. Similarly the return to the conditions favourable to the growth of the coal plants was sometimes a slow one, as the struggle between land and water was year after year more and more in favour of the vegetation.

Thus grew our coal deposits, subject to the fluctuations of the district, and when the miner's pick thus reveals page after page of this wondrous history, it is not unreasonable to hope that some time they will be deciphered even more readily and with greater certainty than the changes now progressing around us.

So far as I am aware, it is noticeable that in all seams these layers are composed of very fine material, that never have the conditions of growth been so abruptly altered as to allow gravel or conglomerate to intervene. Such intercalations might, however, be observed in seams formed on the edges of productive districts where changed physical conditions held sway. So strongly marked were the general conditions of wide spread levels of vegetation during the productive period, that we find, even when oscillations permitted streams to cut through coal beds, they carried only the finest sediments. An illustration of this recently came under my notice in the Cumberland district, where a brook of the carboniferous period had eroded the coal down to and partly through the underclay, the "want" being filled with a fine laminated gray shale. This is also interesting, for from the abrupt passage from coal to shale it is apparent that even at that early date in the history of the future coal bed it must have acquired a certain amount of coherence, enough to form the banks of even a sluggish stream.

There is another interesting point in connection with coal seams which I have not yet seen referred to in any books on this subject. That is the influence of the water and land surrounding the coal producing district upon the purity and homogeneity of the resulting coal bed. It is frequently found by the miner that, as he follows the seam, it changes its character. At first he was proud of the absence of "bands and balls" and of the facility with which he could supply pure coal. Gradually he finds that the bands of shale grow larger with ominous persistence. At last he awakens to the fact that his coal is getting "boney;" finally it proves unmarketable, and he turns his levels in another direction.

Sometimes trial-pits and bore-holes in advance prove that the coal has become a mere mass of carbonaceous shale, or that the seam has ceased. These changes may frequently be explained by the proximity of the vegetation to an arm of the sea or to a river, so that the deposition of mud from floods, etc., at first slight, becomes greater, both in the form of bands, and of a general addition of clayey and silicious matter. Finally a point is reached where the conditions of coal deposition ceased. In some cases the proximity of land covered by sand, which was carried by prevailing winds upon the accumulating vegetation, may explain the presence of an excessive amount of ash in seams not holding bands of shale. It may also have been possible that both these causes united to the deterioration of seams of coal.

This would show that some of the beds were formed in what might be termed broad shallow basins, in the centre of which is found the purest coal, and that it gradually deteriorates each way. The presence of "barren" intervals is of importance, for much money has been spent in examining and proving these marginal districts, when a step further might have resulted in the discovery of workable beds.

The coal from this seam presents a finely-laminated appearance, with a fairly bright lustre, and breaks readily along the deposition planes, which are of a dull black colour, and hold a good deal of mineral charcoal. It is strong and forms little dust or slack. The coal is divided by two cleavage planes, obliquely inclined toward each other, causing it to break into rhomboidal pieces. It is comparatively free from iron pyrites, which is present in small nodules in several divisions of the seam.

The following proximate analyses were made by me on the fresh mined coal carefully sampled as it came from the face. The seam was divided into two portions,—the top comprising 34·4 inches, the lower 89·9 inches.

	Top Coal.	*Low'r Coal.*
Moisture	1·24	·95
Volatile combustible matter.—Fast coking	31·00	23·31
" " " Slow "	27·56	20·52
Fixed Carbon .... Fast "	46·23	60·29
" " .... Slow "	49·67	63·08
Ash	21·53	15·45
Sulphur (from pyrites)	·63	.939
Specific gravity	1·50	1·390
Theoretical evaporative power—Fast coking	6·35	8·28
" " " Slow "	6·83	8·66

The ash from both divisions is the average of two determinations, and is silicious, and of a light gray colour. The specific gravity is from the average determined for each larger layer of coal. The coal in each division did not coke by slow heating, that from the lower division was fairly coherent by fast heating. It may be remarked that an opinion as to the economical coking values of coals formed on their action in the crucible cannot be relied upon for a guide as to their yield in practical coking.

It will be noted that the percentage of ash in the top coal injures its use for general purposes; it can, however, be utilized for colliery work, to the economy of the better coal. The coal from the lower portion is equal to the average of that mined in Pictou County. The theoretical evaporative power compares favorably with that of the coals from the various counties of the Province, as will appear from the following table:

Pictou Co'y,	average of	5	coals.	Theoretical	evaporative	power	8·66
Cumberland Co.,	"	3	"	"	"	"	8·32
Cape Breton "	"	12	"	"	"	"	8·56
Inverness "	"	2	"	"	"	"	7·60

The average evaporative power of the lower part of the seam under consideration is 8·47. All the evaporative powers are calculated by REGNAULT'S formula, for comparison with the admiralty coal trials, although later researches have somewhat altered the values determined by him. The table is taken from the analysis given in my paper on "Canadian Coals," published in the transactions of the North of England Institute of Mining Engineers, for the year 1878.

ART. VI.—ON THE RESISTANCE TO THE PASSAGE OF THE ELECTRIC CURRENT BETWEEN AMALGAMATED ZINC ELECTRODES AND SOLUTIONS OF ZINC SULPHATE. BY PROF. J. G. MACGREGOR, M.A., D.Sc., F.R.S.E.

(Read April 9th, 1883.)

AFTER attention had been directed to the measurement of resistance by the establishment of OHM'S Law, the question was raised whether or not there was at the surface of separation of conductors of different substances a special resistance to the passage of the current, such that the current was weakened by the mere transition from the one conductor to the other. POGGENDORFF* settled this question for metals by so arranging two circuits

* Pogg. Ann. LII (1841).

whose parts had the same aggregate resistance that in the one there was a single passage from one metal to another, in the other several such passages, and finding that the resistances of the two circuits were the same.

In the case of electrolytes there may be not only the form of transition resistance mentioned above, but also another arising from the chemical decomposition which the current effects. Even when no solid or liquid substances are deposited on the electrodes and no gas is given off from them, there is usually some change produced by the current in the surfaces of the electrodes, for they are usually polarised. It is possible therefore that the very process of electrolysis may give rise to such a state of the surfaces of the electrodes that the current is weakened in passing across them.

These two possible forms of transition resistance are usually spoken of together under the one name, there being no experimental means of separating them. The determination of their existence or non-existence is rendered difficult by the fact, that the passage of the current through an electrolyte modifies the resistance of the electrolyte by changing its constitution, and changes the electromotive force of the circuit by producing polarisation.

LENZ† and POGGENDORFF* thought to eliminate polarisation by the use of rapidly alternating magneto-electric currents; and the latter, basing on this assumption, not only regarded the existence of a transition resistance proven, but made an investigation of its laws. VORSSELMAN DE HEER,‡ however, has pointed out that this assumption is not only unwarranted but shown by experiment to be inaccurate. I have arrived at the same result in some experiments made to test the method which KOHLRAUSCH and NIPPOLDT used to measure the resistance of electrolytes. Although I made 250 currents per second pass through various saline solutions from a magneto-electric machine which was made to work with great regularity, yet a sensitive galvan-

† Pogg. Ann. XLVII (1839).
* Pogg. Ann. LII (1841).
‡ Pogg. Ann. LIII (1841).

ometer gave quite large deflections due only to polarisation of the electrodes, and that, however long or however short the time during which the alternating currents were allowed to pass through the electrolytic cell.

LENZ,* admitting the error of his assumption, investigated the subject again in a different way. Assuming the existence of both polarisation and transition resistance in various electrolytic combinations, he showed by experiment that the latter, if it existed at all, must be opposite in its properties to all other kinds of resistance. He therefore regarded its existence as unlikely and joined with OHM† and VORSSELMAN DE HEER‡ in holding that since a transition resistance need not be assumed to account for any known phenomena, (all phenomena which may have such a resistance as their cause being capable of being regarded as consequences of polarisation), it may be ignored.

There is one case, however, in which this transition resistance is dissociated from polarisation, so that its effects cannot be confounded with the effects of polarisation. That is the case in which a current is sent through weak neutral solutions of zinc sulphate between electrodes of amalgamated zinc.§ The electrodes of such an electrolytic cell are not appreciably polarisable. If, then, there is any reduction of the intensity of the current produced by the surfaces of the electrodes, it must be due to transition resistance, not to polarisation. For the change in the resistance of the cell produced by change of its constitution, due to electrolysis, can be made so small by using currents of sufficiently short duration as not to affect the result. BEETZ‖ has already made use of this combination for the detection of transition resistance. His method was that which POGGENDORF used for metals. In two circuits of the same aggregate resistance he passed the current across two and across several surfaces of contact respectively, and found the measured resistance to be the same.

*Pogg. Ann. LIX (1843).

†Schweig. Journ. LXIII, LXIV. See also Fechner's reply Ibid. LXVII.

‡Bull. Sc. phys. nat. Neerland, 1839 (Liv. V), 1840 (Liv. II).

§Du Bois Reymond, Monatsber. Berl. Akad., 1859; Patry, Pogg. Ann. CXXXVI (1869).

‖Pogg. Ann. CXVII (1862).

As I have already pointed out,* however, it is not clear that in the two circuits he used, the number of the times of the current's passing across surfaces of contact was different; and, therefore, the equality of their resistance cannot be held to be decisive of the absence of transition resistance.

I had occasion some time ago, in connection with some experiments on the resistance of solutions of zinc sulphate, to determine whether there was sufficient transition resistance to interfere with the accuracy of my results. Although the measurements, which I made for my own satisfaction, apply only to one special case, it may be worth while to put them on record.

The method which I used was essentially the same as that of BEETZ, but I took precautions which excluded doubt as to the number of times the current had to pass from electrode to electrolyte, and from electrolyte to electrode. I chose as electrolytic cell one devised by Prof. TAIT, for the absolute measurement of the conductivity of saline solutions. It consisted of a box about 20 cm. long, 10 cm. wide and 10 cm. deep, made of pieces of plate glass cemented together with marine glue. It was divided into two nearly equal compartments by a plate of glass cemented to its bottom and sides. The two compartments were joined by a tube which passed through this plate. On both sides of the box, near both ends, narrow strips of glass were cemented to form grooves for holding the electrodes; and the latter were so accurately fitted that their position in the box could not vary. Thus the column of liquid between the electrodes had a perfectly constant length. Two similar sets of strips of glass were cemented on each side of each compartment near those intended for the electrodes. These were intended to hold thin plates of zinc. Thus four such plates could be inserted parallel to the electrodes. The current through the cell passed both across these plates and around them; but the plates were fitted so accurately that the fraction of the current which passed around them must have been indefinitely small. The section of the compartments was so large relatively to that of the connecting tube, and the plates which I used were so thin (about 0.8 mm.) that, though their

*Proc. R. S. Edin., 1874-5. p. 555.

insertion across the cell increased slightly the depth of the liquid and displaced a certain quantity of liquid by a better conductor, the change produced in the resistance of the cell must have been very small. The specific resistance of the solutions I used was about 28 ohms, and the ends of the tube connecting the compartments were about 6 cm. from the electrodes. The total resistance of the cell was about 3000 ohms. With these data it may be easily shown that the change in the resistance of the cell produced by the insertion of the plates could not be more than between $\frac{1}{15000}$ and $\frac{1}{20000}$ of the resistance of the cell itself. The fact that the connecting tube was completely surrounded by the electrolyte and the large volume of the box rendered it easy to prevent any variation of the resistance of the cell due to change of temperature during the short time necessary to make a measurement. The electrodes and the four plates described above, were of zinc, carefully amalgamated. The resistance of the cell was determined by using WHEATSTONE'S bridge, in the same way as when the resistance of a metallic conductor is measured. In the galvanometer branch of the bridge, I used one of Sir WM. THOMSON'S very sensitive galvanometers, whose resistance was so proportioned to the resistances in circuit as to give it the greatest possible sensitiveness. The solutions which I used were of zinc sulphate, bought as pure and refined by crystallization. Their density was about that of minimum specific resistance. In order to prevent the condensation of dissolved gases on the surface of the electrodes and plates, the solutions were boiled before each set of experiments, and the electrodes and plates were kept for some time in a boiling solution of approximately the same density as that in the cell, before being used. I found great difficulty in getting the electrodes and plates into such a state that they would neither originate a current themselves when dipped in the solution, nor become polarized when a current was sent through the circuit. In some cases, however, I succeeded, and was therefore able to make the necessary measurements. In these cases the observations were, of course, very simple. They consisted in the measurement of the resistance of the electrolytic cell, first without the plates, then with the plates, and again without the plates, each measurement being preceded and succeeded by tests of the electrical similarity of electrodes and plates. Without the plates the current had to pass across two surfaces of contact between amalgamated zinc and electrolyte. With the plates it had to cross ten such surfaces. If there had been any transition resistance, therefore, the measured resistances in these two cases should have been different. In no case, however, was I able to detect any difference greater than could be accounted for by the mere insertion of the plates. In some experiments in which I used a connecting tube so small that the resistance of the cell was about 4,000 ohms, I could detect no difference at all. In others in which I used a tube of larger bore, so that the resistance was about 1700 ohms, differences were noticeable, but they were not such as to necessitate the assumption of a transition resistance to account for them.

The apparatus which I used enabled me to measure resistances accurately to ·1 ohm. It is therefore clear that the transition resistance which the current meets in passing eight times across the bounding surface between amalgamated zinc electrodes, of the area mentioned above, and solution of zinc sulphate, does not amount to one-tenth of an ohm, and that therefore the transition resistance at one such surface is not so much as .0125 ohm.

This result was sufficient for the purpose for which I made the experiments.

The above experiments were made in the Physical Laboratory of the University of Edinburgh. I am indebted to Prof. TAIT for his kindness in furnishing me with the necessary apparatus.

ART. VII. NOVA SCOTIAN GEOLOGY—HALIFAX AND COLCHESTER COUNTIES. BY PROF. D. HONEYMAN, D.C.L., &c.

(Read 14th May, 1883.)

BY looking at the Map of Nova Scotia it will be observed that the Counties of Halifax and Colchester are large. Halifax County extends from Lat. 62 deg. 13 min. to 64 deg. 5 min. The eastern side of Colchester is in 62 deg. 47 min. The southern line of Halifax County is the Atlantic Coast. It is bounded on the north by the counties of Hants, Colchester and Guysboro'. A large part of the County of Colchester, which includes part of the Cobequid Mountains, is separated from the County of Halifax by the County of Hants. In this Paper, Parts I., II. and III., I intend to confine attention chiefly to the parts of Halifax and Colchester included between the meridians 62 deg. 55 min. and 63 deg. 41 min.

To the Geology of this region I have devoted considerable attention during the past 20 years. The results of my first work were communicated to the Geological Society of London during the time of the London Exhibition of 1862, by request of the Nova Scotia Commission. Quarterly Journal of G. S., 1862. Paper "On the Nova Scotia Gold Fields." The results of an examination of the Gays River Gold Field, were communicated to the Institute in 1866, *Transactions*. When I read my Paper "On the Geology of Nictaux, Annapolis Co.," to the Institute on Nov. 12, 1877, my new views on the Geology of Nictaux suggested and was followed by the reading of a paper "On the Geology of Halifax County." The latter Paper was not printed, as I considered it proper to defer the publication of views advanced on the age and foreign relations of certain formations, until I had further investigated the character and relations of the Nictaux formations. Since then I have investigated these formations thoroughly and communicated the results to the Institute in a series of Papers. I have also investigated thoroughly the Geology of the region now about to be examined. I have already, in three Papers, traversed the same field, *vide* Papers on the "Superficial Geology of Halifax and Colchester Counties." Localities and names to which I may now refer may be presumed to be familiar.

SECTIONS.

I would define the general geology in three transverse sections following certain meridians of longitude, so that each can easily be located on any map of Nova Scotia. The map on which I have already defined my work is Mackinlay's Map, Geologically coloured, which I exhibited at the Centennial Exhibition, Phila., 1876, and the Nova Scotia Government departments of the Dominion Exhibitions, in Halifax 1881, and Kingston 1882.

SECTION A, LONG. 63 deg. 35 min.

From Cape Sambro the Archæo-Cambro Silurian (lower) extends 34 miles, $1\frac{1}{2}$ miles of Lower Carboniferous succeeds when we reach the Schubenacadie River. North of this is Hants County.

SECTION B, LONG. 63 deg. 20 min.

From Three Fathom Harbour the Archæo-Cambro Silurian (lower) extends to Gay's River Road, a distance of 28 miles, the Lower Carboniferous succeeds and extends a distance of 20 miles to the vicinity of Truro, then comes the Triassic. Beyond are the Carboniferous, Silurian and Archæan of the Cobequid Mountains which do not come within the scope of our Paper, as the Pictou Railway line is our boundary in this direction.

SECTION C, LONG. 62 deg. 55 min.

From Clam Bay the Archæo-Cambro-Silurian (lower) extends 47 miles to Cox's Brook, a tributary of the Stewiacke River. Succeeding this are 12 miles of the Lower Carboniferous, before we reach the Pictou Railway.

The composite term Archæo-Cambro-Silurian (lower) of the above sections, was first used in my paper "On the Geology of Digby and Yarmouth Counties." *Trans.* It was there explained that *Archæo-Cambro* refers to *Formation*, and Silurian-lower to *subsequent metamorphism* with the introduction of gold and associate accidental minerals. The term "grossly cotemporaneous" has been used to characterize this. It seems to me that this is too indefinite and unscientific. My use of the term "Archæan" is that of DANA in his Text Book of Geology, where it is equivalent to the old term Azoic, and includes the Laurentian and Huronian formations. The Huronian seems to include the Lower Cambrian of certain English Geologists, SALTER and others. H. M. Geologocial Society does not recognize this sub-division of the Cambrian. I explained, *Loc. cit.*, that I used the term Cambrian as it is used by H. M. Survey. In my Paper I was led by *fossiliferous* evidence and sequence to regard the auriferous rocks of Yarmouth as of Pre-Silurian age, Cambrian in Formation, and to give them a lease of a portion of subsequent time for alteration, metamorphism and the acquisition of Gold and Gems, &c. The associated granites were prefixed to these and made participants of the same metamorphosing influence, hence the whole complex system was named Archæo-Cambro-Silurian (lower). In my paper, on the Geology of Nictaux, I showed that Geologists had heretofore been mistaken in regarding certain strata as of Devonian age on supposed palæontological evidence. Those views as I have subsequently shown, were confirmed by the palæontological evidence of the Digby cognate formation, which had rightly been regarded as equivalent to that of Nictaux. I also showed that the Middle and Lower Silurian, fossiliferous-strata of Nictaux had not been affected by the *underlying* granite. I showed that the gneisses, which *seemed* to have been affected by the granite, belonged to an entirely different series of rocks, in short, that the granite and associated metamorphic gneissoid rocks were Archæo-Cambro-Silurian (lower) and a continuation of the Yarmouth Series.

In my paper " On Metalliferous Sands," read last session, I showed the correspondence of auriferous rocks in Wyoming, in lithology and minerals, with our own auriferous and the virtual coincidence of age. The only difference is that the Wyoming rocks are regarded as *Huronian*, and therefore Archæan. As our Cambrian is on the border of Azoic, with only doubtful life, there seems to be no formidable obstacle in the way of regarding our gold fields as closely Archæan. However, in the meantime we may characterize our gold fields as Archæo-Cambro-Silurian (lower.)

While I consider that we have little (if any) interval or break between the auriferous and succeeding formations, in Annapolis, Digby and Kings Counties, the case is much different in Halifax and Colchester. This will be seen by referring to sections "A," "B" and "C." It will be there observed that the Archæo-Cambro-Silurian (lower) is succeeded by the Lower Carboniferous. If one were thus to infer the age of the former from that of the latter, it would be concluded to be of Devonian age. This irregular sequence, and the want of distinct fossiliferous evidence, has always been a difficulty in the way of the satisfactory correlation of the formation of our gold fields. In my paper read before the Geological Society of 1862, I illustrated the geology of the gold fields by an examination of the railway sections, especially from the Windsor Junction to Windsor, in connection with the Waverley gold fields and its barrel quartz. (*Vide* paper [with illustration] in "Quarterly Journal," 1862.) I reasoned thus: The rocks are widely different from any member of the Arisaig series, at Arisaig, or elsewhere, in the eastern part of the Province, which ranges from the Devonian to the Middle Silurian. They are extremely metamorphic, more so than any of the preceding. Gold has now been found in them in sufficient quantities to be of economic importance. These considerations seem to warrant the conclusion that the formation in question is Lower Silurian. The author of "Acadian Geology" had, on other considerations, come to the same conclusions. In the discussion that followed the reading of my paper, two eminent geologists, only, took a part. The one considered the rocks of our gold fields to be of Devonian age, the other agreed with me in the views that I had taken. In a subsequent conversation which I had with the former, the granites were referred to, which had been noticed as occurring at Mount Uniacke, but had not been taken into account in the discussion. It was *then* agreed that they were of igneous origin, and might be of Devonian or any age.

Among all the interesting exhibits of gold at the London Exhibition of 1862, there was one which was to me peculiarly interesting. This collection stood at the entrance to the Eastern Annex, in which was the wondrous economic mineral display of Great Britain. The exhibit was from the Dolgelly gold field in North Wales. Here were a magnificent bar of gold, rock specimens and gold in its matrix. Accompanying this was a map by Mr. T. A. Readwin. A pamphlet was distributed, entitled, "Notes explanatory of a map of the faults of the Dolgelly Gold District, undertaken for Mr. T. A. Readwin, by J. W. Salter, F. G. S., &c." I was fortunate to secure a copy of this pamphlet, which I have carefully preserved as a memento of pleasant intercourse had with its illustrious author, and pleasant walks among the various departments of the exhibition, where any thing relating to "Silurian" was to be found. I looked upon this gold collection as intimately related to that of the gold fields from Nova Scotia, although there seemed to be a difference in age,—the Dolgelly gold being of Cambrian age, while the other was considered to be of Lower Silurian age. The researches and discoveries in the palæozoic geology of old Acadia—New Brunswick, Nova Scotia and Cape Breton—during the past 20 years, have added Primordial or Upper Cambrian, Upper Lingula, Flags, Hudson and Trenton, with their characteristic forms of life. Every effort has been made, especially by diligent study, of the rocks Saint John and Halifax, to correlate our gold fields with the most ancient of the Palæozoic series. The old Igneous rocks have, to a great extent, been resolved into Archæan Metamorphic rocks—Laurentian and Huronian—so that the Lower Cambrian, or Dolgelly, auriferous period seems now to be the only resting place for our own auriferous series of rocks. The want of life, or its existence in low and doubtful forms, seems to indicate this. This view accords with the conclusion at which I had arrived by the lithology, sequence and palæontology observed in the Western Counties, especially of Digby and Yarmouth.

CORRELATION.

Previous investigations in Kings and Annapolis Counties, and especially at Nictaux in the latter, had *re*-conducted to Dolgelly and led to a correlation with the *auriferous* formation of Halifax County. In my unpublished paper, read at the same meeting, on the 12th of November 1877, that I read my published paper, "On the Geology of Nictaux," I made use of SALTER'S notes on READWIN'S Map and compared the Halifax Quartzites and Argillites with the "Lower Cambrian," "Barmouth and Harlech Rocks of Prof. SEDGWICK." "The Dolgelly Gold district comprehends the upper part of the Lower Cambrian or Barmouth Rocks, and the lower part of the Upper Cambrian or Lingula Flags (Primordial), which range all along the Barmouth estuary and thence northwards to Festiniog." The whole series of these rocks (Barmouth) consists of a very hard sandstone with beds of purple slate, which occur chiefly in the middle and lower portions of the series, but the upper sandstone beds are frequently interstratified with bands of green slate which distinguish it readily from the overlying formation, viz:—The Lingula Flags or Upper Cambrian. This is a triple formation measuring about 6000 or 7000 feet in thickness, according to Professor RAMSAY. It has been divided by my own research, into a *lower* group of black slate and trappean shale, a *middle* group of sandstone, and a thin upper group of very black shale, which in North Wales is rich in fossils."

"Of these formations we have only to deal with the lower, for in that only, at present, are the gold veins worked in the district, but the gold is not confined to these lower members, for the productive mine at Castell Carn Dochan is in much higher rocks. Indeed it is at the junction of this formation with the underlying Cambrian grits (quartzites) that the principal bearing lodes are found." Pp. 1, 2.

SALTER'S description of the Barmouth rocks might with very little change be employed in describing our quartzites (grits) and argillites the only difference existing between the English series and our own seems to be accidental. *Their* metamorphism may have taken place in Upper Cambrian time, which seems to correspond with our Lower Silurian which is meant to include the Primordial of Saint John, N. B., the Lower Lingula Flags and the Mira ridge, C. B., *Olenus* and *Agnostus*, Upper Lingula Flags of SALTER'S Appendix to RAMSAY'S Geology formation of North Wales.

ARCHÆO-SILURIAN (LOWER).

This is a term which I use to denote the granites of the series. At Nictaux these were considered to be igneous rocks of Devonian age and were considered as having so metamorphosed the supposed Devonian fossiliferous rocks, as to have converted them into gneissoid rocks. The inclusion of portions of these gneissoid rocks was also regarded as conclusive evidence of the igneous origin of the granite. The old view is that the granite is of igneous origin and that it is an intrusive rock, the new and orthodox view is that granites are generally metamorphic rocks, and not necessarily intrusive rocks, and that remetamorphism may account for the apparent fusion and intrusion. At Nictaux I found, *first* that the supposed Devonian rocks having fossils are of Middle Silurian age, *second* that the rocks by which they are intruded and metamorphosed are igneous diorites; *hird* that in positions where granite and the fossiliferous rocks were in actual contact, the latter were very little metamorphosed and certainly not converted into gneissoid rocks. The granite appeared to be an underlying rock. It had evidently been granite when the other rock was formed upon it. It is therefore at least of pre-Middle or Lower Silurian age.

The gneissoid rocks are identical with those on the west side of the N. W. Arm, Halifax, the granites are identical, except that the variety is greater at Nictaux, the inclusions are similar to those which are of frequent enough occurrence in the vicinity of the line of junction of the granites and gneissoid rocks. There is, therefore, no reason why we should regard the granites of Halifax and county as of different origin and age from those of Nictaux.

ARCHÆAN.

In our field there are three granitic areas corresponding with the three sections. The area of section 1 extends from Halifax Harbour, westwards to St. Margaret's Bay, a distance of 20 miles, and from the Atlantic coast northward to Hammond's Plains, a distance of 18 miles.

The area of section 2 on the E. side of Fletcher's Lake beyond the Windsor Junction, I. C. R., its extent has not yet been ascertained.

The area of section 3 extends from Lake Major to Ship Harbour, and beyond, a distance of 27 miles. Where I have examined it between Meagher's Grant and Musquodoboit Harbour it commences about one mile north of the main road, Musquodoboit Harbour, and extends 6 miles.

It is thus evident that this formation occupies a very large portion of our field and is entitled to greater consideration than is generally conceded to it.

The part of this formation that is most accessible is the area of 1st section, this is admirably exposed on the west side of Halifax Harbour, the N. W. Arm, and the road at water works and there is little difficulty in traversing it in any direction. I have conducted the Institute over the most exposed portion from Purcell's Cove to York Redoubt Point. This has also been an interesting field study to my students in geology during the past 10 years, so that by this time I am pretty familiar with its details and can dispense with my field-book generally in giving an account of it.

The granites of the region are generally coarse in structure. It is only on the ground of use and wont that they are entitled to the name. Their constituent minerals are, as usual, Orthoclase, Muscovite and Quartz, the two first minerals generally prevail. They are not quartzose and consequently are not first-class building stones. They polish well however and *easily*, and are favorites with workers, (more so than the granites of Shelburne, which are truly granites—quartzose granites). The orthoclase is white, often very white, the mica is black and grey, the quartz is often hyaline and often smoky. In some places the mica of the granite is black, in others it is grey, sometimes both occur. The rocks are largely porphyritic with large crystals of orthoclase, especially the very white variety. Some years ago I found in one of the cuttings of the water works, granite with deep red orthoclase, this has a green foliated mineral in place of the mica. A Museum polished specimen of this rock is very beautiful. The polishing has removed the green mineral, so that the surface is singularly marked. It was thought that the stone would be adapted for ornamental purposes, its extent was found to be small.

MINERALS.

In some places the minerals of the granite are segregated, one of the constituents being found without the other, mica is thus found and also feldspar. Here the mica may be said to constitute the rock, and there is no difficulty in securing specimens of any size. Around these the mixed rock is so coarsely constituted that it would pass for a gneiss in acknowledged Archæan regions. In one place, under a bridge at Long Lake embankment, nothing but feldspar is seen of clayey colour. In this black tourmaline abounds in large crystals. A specimen which was brought to the Museum is very singular, it is composed of feldspar and quartz and mica, the feldspar and quartz are very marked, long and large tourmaline crystals pervade, passing indiscriminately through the quartz and feldspar indicating simultaneous crystallization of the three. Another large specimen from the same quarter is sub-conical in form, it is composed of feldspar and mica plates, the latter are arranged so as to give shape to the whole. In some places the quartz is snow-white, in this crystals of jet black tourmaline are often found prevailing in clusters. Specimens of those in the museum collection are very striking. There is a specimen in our Webster Collection, it is probable that it has come from the granite region of Paradise, Annapolis County, where white quartz with groups of black tourmaline is of frequent occurrence. The specimen is a crystal of beautiful smoky quartz (cairngorm) with long crystals of black tourmaline permeating the interior. Crystals of tourmaline are of frequent occurrence in our granite area. Groups are sometimes arranged in stellar forms. Small crystals of colourless quartz are often found in the granite under examination. I have a large crystal of opaque smoky quartz which is said to have come from the Queen's granite quarry, where black tourmaline is also found.

CAMBRO (SILURIAN).

The rocks of this series are, 1, gneissoid (ironstone).
2, micaceous.
3, Argillites, slates.
4, " shales.
5, Quartzites (grits).
6, " banded.
7, " calcareo-

(The line of the granite is generally N. E. and S. W. while the line of strike of the formation that succeeds or *abuts* is generally E. and W.)

While all the members of this series are readily recognisable no line can be drawn as a separating line, they all pass into each other insensibly, gneissoid into micaceous and argillites, argillites into quartzites and quartzites into calcareo-quartzites, e. g., Examining the Queen's quarries on the W. Side of the N. W. Arm, we first find the two formations in contact. Abutting against the granite we have a micaceous-schistose rock with distinct bedding, E. and W. strike and North dip, I generally try to secure a specimen at a junction of this kind so as to illustrate it, I did not succeed here, the granite and the schist always separated. This rock passes into the hard gneissoid (ironstone) of the quarry. On the East side of the Arm, at Point Pleasant, we have the same becoming a coarse ferruginous and argillaceous rock with the same strike and dip. The ledges on the east side of Point Pleasant are a continuation, these are generally argillites. 2. At Pleasant street, not far from the Park, there are beautiful exposures of argillite strata. Coming to the shore on the opposite side we find a great ledge of similar strata. At the side and back of these are argillite shales and massive quartzites with veins of quartz, all the three pass into each other insensibly. In the gold fields argillites are seen when mining where the surface would lead to the expectation of only quartzites. 3. The Calcareo-quartzites are a striking illustration. I first observed these on the shore between Cow Bay and Cole Harbour. When walking along the shore, I was surprised to find certain rocks singularly worn, as I have seen Lower Carboniferous Limestone worn on the sea shore, by the action of the waves, while other parts of the same rock had the usual appearance of the hard quartzites exposed to similar action. I found in subsequent chemical examinations that 18 per cent of the highly worn parts of the rock was calcareous, while the other parts were quartzite. The acid only can indicate the passage with precision, which is gradual, the sea indicates it approximately. Similar rock and indications are observed on the Eastern Passage, opposite Lawlor's Island· The constitution of the original sediment and accident are doubtless the causes of the variation. The series, therefore, is not divisible into subordinate members or groups.

SYNCLINAL.

On the East side of Pleasant Park, at Steele's Pond is a point where there was in olden times a Three Gun Battery. The rocks of this are exposed on the shore, and exhibit interesting structure. They are seen to dip on the right to the South and on the left to the North. In the centre the strata are bent so as to display a series of parabolic curves. A photograph of this taken by the photographer of H.M.S. Challenger for Sir C. Wyville Thomson, is a very striking picture.

SECTION.

On the right or north of the Syncline the argillite strata become confused, they then become shaly. In the shales I found forms which at first sight seemed to be graptolite stipes but turned out to be chiastolites. In this band all is confusion, dip being at different angles and strike in all directions. At length the strata become slaty having a distinct southerly dip and cleavage at right angles to the dip. The extension of these westerly outcropping in a field has similar structure. Proceeding in the same direction along Pleasant street, splendid outcrops are seen dipping in the same direction, opposite the last of these we have again a fine outcrop on the shore; here the dip is also southerly and the strike nearly East and West. This outcrop was referred to above, as exhibiting slates and shales, passing into quartzites with veins of quartz. These outcrops are an interesting study, not merely on account of the transition just referred to, but also on account of the metamorphic phenomena which are beautifully striking and instructive. The last, street section, shows beautiful wavy lines of bedding with a southerly dip, slaty cleavage at right angles, joints and other striking features, e. g., concretions? around which the wavy lines are seen to curve and then return to their original course. Some years ago I examined similar argillites exposed in blasting the foundation of the Young Men's Christian Association Building in the City, these were seen dipping in the same direction with similar cleavage. A specimen in my rock collection in the museum, shows pyrite in flat rhomboid crystals which might be mistaken for ganoid scales. If the arrangement from this to the syncline were to be regarded generally regular, it would indicate a great thickness of argillite strata. There may be doubt, however, on account of obscuration of the intermediate strata, as well as the probable causes of the existing arrangement of strata, lateral pressure, non-intrusion. Returning to the syncline and proceeding to the left, south, we have first an obscuration of strata, then a point with confusion of strata, again, obscuration and then a ledge with crumpled bedding of argillites and a northerly dip. Here too there is cleavage and joints with glaciation and scooping in the line of joint, showing beautiful lines. The glaciation is S. 38° E. A ledge to the south of this and next to the fort at the *Point*, is composed of quartzite strata with overlying slaty strata, an arrangement similar to that observed at Cranberry Head, Yarmouth. (*Vide* Paper on the "Geology of Digby and Yarmouth Counties." *Trans.* 1881–2).

On the quartzite *stratum* are seen *markings* when the shaly strata are removed, these are considered to be *Helminthites* (worm tracks). I have pointed out these again and again to members of Institute, to students and others for several years. Every season there are new exposures. I have tried to secure specimens for the museum but without success, on account of the great hardness of the *stratum*.

On the west of the syncline, the confused strata on the right, the obscuration and confused strata on the left, is the road succeeded by confusion. Steel's Pond and Miller's Field, with wonderfully crumpled strata on either side; Pine Hill, the seat of the Presbyterian College, beautiful country residences and the Penitentiary. We have now reached the North West Arm. Crossing to the opposite side we come to the Sugar Refinery. Here we find the argillites of the syncline continued. The rocks of which these are a part, are exposed in a beautiful and instructive section which I would now describe. The stratified rocks—argillite and gneissoid—extend a considerable distance to the right, N. W. and left. In the latter direction they extend to the Point, at the entrance to the Arm where we have the Ironstone (gneissoid) Quarries. In the section succeed the granite of the Queen's quarries. The gneissoid rocks have the northerly dip of the Point Pleasant extension and of the previous section. On the road to the Queen's Quarries they are seen butting against the granite as a distinct micaceous schist. At the Junction the two are so loosely coherent that I found it impossible to secure a *specimen* which would indicate the Junction. We now come to Purcell's Cove, where the gneissoid rocks succeed the granite in section and butt against the granite and maintain a northerly dip. The granites again come forward to the section and continue as far as Falkland Village, where they are again succeeded by gneissoid rocks. On the shore the first of the latter is seen to *overlie* the granite. At the Junction they are so firmly coherent that there is no difficulty in securing a Junction specimen. From this point to York Redoubt point, the stratified rocks are seen in the section., while the granite retreats, forming a bay which is occupied by the gneissoid rocks. These have an east and west strike and a northerly dip, up to York Redoubt Point. As the granite retreats on the north side of Falkland Village, the gneissoid rocks dip toward it, *seemingly* into it, not away from it. There is no anticline. On the shore the rocks are very ferruginous. Pyrite is found in them in large crystals. Some of the strata are very andalusitic. The mineral is in slender, pearly prisms. These are often arranged in stellar forms. One stratum is covered with these. In York Redoubt, the strata which is seen to overly the granite which rises on the south side of the fort, have a northerly dip and are very andalusitic. The extension of the shore andalusitic strata in the granite bay, are schists without andalusite. This is their character near the Junction with the granite. In the section south of the Redoubt pier, is another kind of rocks which are hard to characterize; they might be called a quartzite. In these are abundance of *discinoid* forms. I am very doubtful regarding their character. I find them in three other localities to which I will yet refer. The inclination of strata is low and its direction doubtful until it is decidedly westerly, and towards the associate granite. The granite then comes into the section and alternates with the stratified rocks. At the Point the latter make their exit, and then the granites are the only shore rocks. I have reason to suppose that the stratified rocks appear again at Portuguese Cove. At the Point the stratified rocks have a slight easterly inclination. The junction of these with the granite is very interesting. The two are seen dove-tailing, but not blending. A museum specimen shows this in a striking manner. The stratified part is banded with a right angled termination; another piece is pointed. The granite seems to have been inserted by fusion. In the *discinoid* part there are long veins of quartz with mica. I regard these phenomena as having been induced by *re-metamorphism.*

I am here reminded of an observation which I made on the Nepisigit river, on the Bay des Chaleurs, New Brunswick. *Vide* Paper *Trans.*, 1875-6: "A month among the Geological Formations of New Brunswick."

At the "Rough Waters" we have the junction of the granite and the Bonaventure formation (Lower Carboniferous), granite,

granite *debris*, and sandstone or grit. I became aware of the existence of a distinct stratum of debris when I was trying to find the junction of the solid granite with the sandstones, in order to secure a representative specimen. The debris had been previously observed by Sir W. E. Logan's Geology of Canada. It has also been noticed by Mr. Ells, in his recent report, and by him *united* with the Lower Carboniferous, as the lowest bed of the series. I cannot help believing that if metamorphism were induced in this region, of the intensity to which the Halifax rocks have evidently been subjected, phenomena similar to those under examination would be the result.

Returning to the N. W. Arm part of the section, I would again notice the junction of the Queen's Quarry granite and the gneissoid and schist strata. Dr. Warren and I investigated thoroughly the extension of this line of junction, and defined it as exactly as possible on the Admiralty map of the harbour as we proceeded. We were able to do this on account of the scantiness of the vegetation, the contrast between the white granite and the black stratified rocks, and the minute exactness of the contour lines of the map. The east and west penetrations of the strata into the granite were numerous, some of these were too small for indication on the map, but the larger ones were defined, until we reached the vicinity of the Coal-pit lakes, where the rankness of the vegetation obscured the lines of junction. Afterwards I resumed the investigation, when I examined and observed the strata of the syncline in and around Williams' lake. On the road at the top (west) end of this large lake, the stratified rocks and the granites were again observed in junction. The two were very intimately connected, so as to be inseparable, yet there was no blending. The stratified rocks, in considerable width, proceeded onward, crossed the York Redoubt ~~point~~ road, and seemed to terminate abruptly in the bushes on the west side, —low, swampy ground, extending beyond, to Long Lake I referred to this extension in my paper of last session, when describing the rocks on our way to the Rocking Stone. We encountered it after a tramp over granites, extending from the vicinity of Melville Island. I therefore recognized it as an old acquaintance. Their occurrence between two sets of granites would doubtless be perplexing to any one but myself, who am the only one that has investigated its true relation to the associate granites. These are thus divided into two by their intervention. The second granites in great force cross easterly, and are beautifully exposed on the SANDFORD FLEMING road and property, and also in the N. W. Arm section. In the latter they are seen in junction with the gneissoid (ferruginous) rocks, as well as in the heights which intervene between the road and section. In this locality pieces of gneissoid rocks are also seen imbedded in the granite in like manner as at Nictaux. From this one might be led to infer the existence of the gneissoid rocks prior to that of the granites, as has been done in the case of the Nictaux gneissoids. Here, as at Nictaux, we attribute the phenomena to re-metamorphism of the granite during the metamorphism of the stratified rocks. In the section on the arm we find argillites succeeding the granites and gneissoids. In these I found numerous crystals of chiastolite. These are prismatic, and of considerable size, larger than the Falkland and York Redoubt andalusite crystals. The granites appear on the side of the road, opposite Melville Island, and then retreat into the elevated and woody region to re-appear on the St. Margaret's Bay road, at the Water works. Here, again, they are seen in junction with the gneissoid. They again retreat, and after proceeding onward, advance to Birch Cove, on Bedford Basin, where they are quarried for ornamental purposes. Their mode of occurrence in Hammond's Plains is well described by Mr. HARE. For information regarding their junction with the stratified Cambrian rocks, I would refer to his paper. *Transactions* 1880-1.

END OF PART I.

ART. VIII. NOTICE OF NEW AND RARE PLANTS. By GEORGE LAWSON, PH. D., LL. D. *Professor of Chemistry and Mineralogy, Dalhousie College and University, Halifax. Nova Scotia.*

(Read 12th December, 1882.)

Part I. Plants collected at Blomidon, Bay of Fundy, King's County, Nova Scotia.

A familiar feature in the physical geography of Nova Scotia is the North Mountain, a table-topped ridge that runs for 80 miles in a straight, unbroken line along the south-eastern shore of the Bay of Fundy, from Annapolis Basin on the south-west to Minas Basin on the north-east, and thus shelters the fruitful valleys of the Annapolis and Cornwallis Rivers. One of the most attractive features in the scenery of Nova Scotia is the bold and strikingly picturesque promontory of Blomidon, rising to 400 feet in height, which forms the north-eastern termination of the North Mountain, and now looks down upon the fertile stretches of waving meadow, blossoming orchards, and scattered towns and villages, as it did in the olden time on the less ambitious hamlets and carefully cultivated fields of the French farmers. The physical and geological features of Blomidon,—its red sandstone strata, mostly covered by a debris-slope, and its continuous summit cliff or wall of dark trap—have often been depicted by pen and pencil, and its zeolites and other treasures of mineral species are shown in most of the public museums of America and Europe. It is not so well known that Blomidon is a rich pasture for the botanist.

In July last an excursion to Blomidon was undertaken, chiefly for the purpose of studying its ferns. The party consisted of Colonel COLLINGWOOD, R. A., and his son PERCY; Dr. CATELL, Deputy Surgeon General; Mr. P. JACK, Mr. GEO. THOMSON, and myself. Having reached Canning the night before, we started early in the morning for Blomidon, sailing down with the tide in a yacht to a place called Big Eddy, which affords convenient anchorage.

The day was spent on the cliffs, and we returned in the evening laden with plants. Many of these have been planted in gardens for study. At present I wish merely to refer to a few of the more conspicuous and interesting species, with the view of promoting further search in what is obviously a very rich locality.

On the summit cliffs many unusual plants were collected, chiefly of northern or alpine type, such as *Saxifraga Aizoon* (Jacquin), which was first detected on Blomidon several years ago by Mr. JAMES H. HARRIS of the Halifax Nursery. It was found by our party in great quantity and in full flower, its masses hanging by its twine-like roots from the perpendicular faces of the trap cliffs, or nestling in cracks. A living plant was shown to the meeting, also dried specimens, illustrating its range, one from Prof. CARUEL, of Florence, collected "in Apenninis Etruriae," another from Snaehettan, Norway, (T. ANDERSON, M. D.) and a third from Point Rich, Newfoundland, (J. RICHARDSON). It is not a British species. It was introduced into English gardens in 1731, and has been long grown in collections of Alpine plants; but it has remained for Mr. POWER, Superintendent of the Halifax Public Garden, to bring it into use for decorative purposes. He is propagating it largely as an edging and bedding plant, and it will, no doubt, form an interesting feature in the artistic flower-beds next summer.

Sedum Rhodiola was also found in quantity and partially in flower, the male and female flowers being mostly on distinct plants. The plant was first found as a Nova Scotian species at Cape Split, some years ago, by Messrs. JACK, THOMSON and PAYZANT. The Rev. Mr. J. FRASER CAMPBELL (now in India) brought it from either Labrador or Cape Breton, and specimens are now on the table from Newfoundland and Orkney.

Cerastium arvense, although an introduced European plant in the United States, is a true native on the Blomidon cliffs, reminding one in its mode of growth there, of the *C. alpinum* of European mountains.

Tussilago Farfara affords every indication of being indigenous in this wild locality. It is not known to grow in cultivated grounds nearer than Yarmouth, in the south-western extremity of the Province, and, as an introduced plant is rare in Nova Scotia. Its occurrence at Blomidon, under circumstances which indicate it to be indigenous, is of special interest to botanists. I have appended a few notes on this plant. *Campanula rotundifolia*, the blue bell of Scotland, is also quite indigenous here, although it grows as an introduced plant only near Twelve-mile House, Halifax county.

The bank of debris that slopes from the top cliffs of Blomidon to the shore, is covered in most places with a growth of birch and other common, chiefly hardwood, trees, beneath which, and especially near the top, in shelter of the cliff and huge masses of rock, there are scattered about magnificent clumps of ferns. *Struthiopteris germanica*, the ostrich plume fern, grows in great luxuriance; also *Polystichum angulare* var. *Braunii*, together with the more common Lady fern, *Athyrium filix femina*, and the *Lastrea dilata*, in many puzzling forms, one of which, var., *Blomidonensis*, with remarkably broad deltoid fronds of great size, is strikingly different from all other forms of this species.

Botrychium Virginicum was also found, not plentiful by any means, but some of the specimens were very fine. *Polypodium vulgare* hung in great green mantles over the bare rocks, and in stony places tufts of *Lastrea marginalis* were everywhere to be seen.

Cystopteris fragilis was found in many places on the lower part of the sloping bank where the rock appeared at the shore, but the specimens were larger and finer in the crevices of the upper cliff. The prevailing form was that described as variety *McKayii*, which differs greatly, in its distant, not approximate, pinnæ, and other characters, from all ordinary European forms, but is probably the most common form of the species in America. It is in fact so common here that American botanists not unnaturally look upon it as the normal state. *Woodsia Ilvensis* was also found extending up the face of the cliff. *Polypodium Dryopteris* and other more common ferns need not be specially noticed.

Returning to Canning in the evening, we started next morning, and botanized the gorge through which Dr. HAMILTON'S road winds up to the summit of the North Mountain. Here also there was a magnificent growth of ferns along the banks of the rill, composed principally of *Lastrea marginalis, L. dilatata (spinulosa), Polystichum acrostichoides, P. Braunii, Struthiopteris germanica,* not very plentiful, *Polypodium Phegopteris* and *Dryopteris,* with fine patches of var. *erectum* of the latter, *Athyrium Filix femina, Polypodium vulgare,* &c. Here, with var. *McKayii* of *Cystopteris fragilis,* we found a single tuft of a form with broad leafy approximate pinnæ like the ordinary European state of the plant. It was at this place that Mr. JACK found, some years ago, a tuft of *Woodsia obtusa,* a species which, although not so very rare in the United States, was not previously ascertained to be Canadian. It has indeed been regarded as a Canadian fern, but in my Synopsis, published some time ago, it was pointed out that there was then no evidence.

On the following day we visited the "Look Out," a favourite place of resort for visitors, from which there is a magnificent view of the Cornwallis Valley. Here we obtained a supply of *Woodsia Ilvensis* and also a very few specimens of *Asplenium Trichomanes,* which was very scarce, but was subsequently found on a cliff in a gorge to the westward of Canning, by Colonel COLLINGWOOD. Near the same place Master COLLINGWOOD found *Veronica Americana.* It is necessary to mention, in the interest of visitors to the Look Out, that there is, along the base of the cliff and amongst the stony debris, a great profusion of the Poison Ivy (*Rhus Toxicodendron*), which causes, on many persons, by simple contact, a disagreeable and even dangerous eruption on the skin.

It is remarkable that, with exception of a few local species, nearly all the ferns of Nova Scotia are to be found on the North Mountain.

Part II. Plants discovered at Woodstock, New Brunswick, by Peter Jack, Esq.

In September last Mr. JACK visited Woodstock, and there made some very interesting discoveries. His attention was called, in the greenhouse in the garden of Mrs. CHARLES CONNELL, to a fern found by the gardener in the neighbourhood during the fall of 1881, whilst gathering leaf mould from under the snow. Mr. JACK, perceiving that the fern was *Scolopendrium vulgare*, an extremely rare species on the American Continent, for which we have only the one Canadian locality at Owen Sound, visited the place, some six miles distant, where the gardener had obtained it, but no trace of the plant could then be found. The plant in the greenhouse was a seedling, apparently of two or three years growth. The gardener (Mr. SUTTON) subsequently, however, succeeded, by diligent search, in finding two small plants, both of which have been forwarded to Halifax, and are now in Mr. JACK'S greenhouse. They came with the native moss and mould still attached to their roots, and effectually confirm one of the most interesting fern discoveries made for some years. Since then two more plants of larger size have been received by Mr. JACK, and a frond of one of them is now presented to the Institute. Whilst at Woodstock he visited the station for *Adiantum pedatum,* a wood six or seven miles distant, and found it to be abundant. But he found at the same place a much greater rarity, viz., *Aspidium Goldianum,* not previously known to exist in the Maritime Provinces; also:

Viola Canadensis, which had been found for the first time in New Brunswick by Mr. CHALMERS, of the Geological Survey, a few days before, at another place. At Grand Falls Mr. J. found *Woodsia glabella,* which, so far as known, had only been ascertained to exist in one other place previously in New Brunswick, viz: Tunnel, at Restigouche. *Pellæa gracilis* was found in cleft of rock opposite Woodstock.

Part III. Localities for species of Botrychium.

I have to add the names of a few very interesting forms of Botrychium found during the past summer at Truemanville, in the County of Cumberland, by CHAS. H. TRUEMAN, a science student of Dalhousie College. These are *Botrychium lanceolatum,* Angstrom, and two forms of *B. matricariæfolium,* one of them corresponding to the large state figured by Prof. EATON, from Utica, N. Y. S., the other to what he calls the commonest form.

Mr. JOHN BRITTEN, of Petitcodiac, N. B., writes me that he has found *B. matricariæfolium* in New Brunswick.

Mr. JAMES VROOM, of St. Stephen, N. B., writes me that both Mr. BRITTEN and Prof. BAILEY collected B. *simplex* at Petitcodiac in 1881, and that Prof. BAILEY found it in the College Grove at Fredericton about ten years ago. I have not seen the specimens.

Mr. H. H. BELL of Halifax, found *Botrychium Virginicum* on Partridge Island at Five Islands, in Colchester County, in July 1881. The Island is one of the five from which the place gets its name, is small but high, with very steep rocky sides, bare in most places; a path at one point leads to the top, which is thickly wooded. The fern grows on the top; found three or four specimens.

Part IV. Plants grown by Mr. Jack at Bellahill, from seeds collected by Mr. Howard Stokes, in Manitoba.

Mr. HOWARD STOKES, formerly of Halifax, collected seeds of a number of the Prairie flowers in the Pembina Mountain district in the summer of 1880, and sent them to his father, B. Stokes, Esq., formerly Storekeeper of H. M. Dockyard, now in Europe. The seeds were sown at Bellahill by Mr. JACK, who also gave portions to the Superintendent of the Public Garden. They flowered in the summer of 1882, and proved to be the following species:—

1. *Anemone cylindrica,* Gray. The Cylindrical or Long-Fruited Anemone, so named from its achenes being arranged spike-like on a much elongated receptacle. This plant is fully described in my Monograph of the Ranunculaceæ published in a former part of the Transactions of the Institute.

2. *Liatris scariosa,* Wild, a rather showy plant, and very variable in size and appearance. It extends from New England to Wisconsin and other Western States and southward, as well as into the British Territories; the specimens from the extreme

western part of Ontario and others collected by Senator SCHULTZ in several places in the North-West, show its extensive range.

3. *Gaillardia aristata.* The Gaillardias are all southern and western plants, none occurring east of the Mississippi, *G. picta* is a favorite in gardens. This one is quoted by TORREY and GRAY from Missouri, Saskatchewan and Oregon. But the form sent by Mr. STOKES is a large robust lanuginose plant that does not agree with any of the forms described in botanical works. Prof. MACOUN, to whom I showed specimens, informs me that this is the form the plant takes when grown on the prairie land after it has been ploughed.

4. *Helianthus giganteus* var. This is also a form of a very variable species.

5. *Heliopsis lævis*, Persoon, a rather diminutive but neat broad-leaved perennial sunflower, the only sunflower, in fact, fit for a button hole, if any are. It derives its name from its resemblance to the true sunflower. It grows in Ontario as well as on the Western Prairies.

Physostegia Virginica var. *speciosa.* Gray, False Dragon Head. This is a robust, showy perennial, 4½ feet in height when in flower, with dark green lanceolate strongly serrated leaves and large spikes of variegated purple flowers. This plant is different from the ordinary garden form of *Physostegia Virginica*, being much larger in all its parts, with larger, darker, almost coriaceous leaves, and long spikes of very bright coloured flowers. It is so different that it has been described as a distinct species. It is the *Dracocephalum speciosum* of SWEET'S British Flower Garden, t. 93, and *Physostegia imbricata* of Hook. Bot. Mag. t. 3386. It differs from the ordinary cultivated form of the species by its dense spikes of horizontal flowers, the spikes panicled; the flowers are also of a darker and richer colour.

Petasites vulgaris, a large English herb with leaves two feet across, City of St. John, where it was observed in vacant lots in the summer of 1881. It seems to have spread from a garden after the great fire, and is fairly naturalized. Additional particulars respecting this and some other plants will be given in a future paper.

A number of interesting localities for rare Ferns were also noticed, from information furnished by Mr. VROOM, including new stations in New Brunswick for *Adiantum*, *Asplenium thelypteroides*, *Cystopteris bulbifera* *Woodsia Ilvensis*, *Botrychium Virginicum*, and *Woodwardia Virginica*.

ART. IX. ON THE BONE IN THE HEART OF THE MOOSE. By J. SOMERS, M. D.

(Read January 8, 1883).

IN most ruminants, especially the larger kinds, there is a bent bone at the base of the heart, on the septal side of the origin of the *aorta*, and imbedded in the tendinous circle which gives attachment to the muscular fibres of the ventricle. In the giraffe this bone was two-thirds of an inch in length. Two such ossifications of the sclerous tissue have been met with. In oxen and red deer, an ossified and unossified piece of fibrocartilage is more commonly observed. In the horse these bodies at the septal side of the aortic ring, are rarely ossified until extreme age. *(Owen, Comp. Anat. Vol. 3, p. 523.)*

The fibrous structure of the heart consists of the firm rings which surround the auriculo-ventricular and great arterial orifices. All of these fibres are more strongly developed on the left side of the heart. The left auriculo-ventricular ring is firmly blended at the fore-part of its right margin with the fibrous structure surrounding the aortic orifice, and behind the aortic opening, between it and the two auriculo-ventricular openings there is found a fibro-cartilaginous mass, which is connected with the several fibrous rings, and to which the muscular substance is also attached. In some large animals, as in the ox and the elephant, there is a small piece of bone in this situation. *(Sharpey & Quain's Anat. Am. edition, 1849. Vol. 1, pp. 481-2.)*

The above quotations from OWEN, and SHARPEY and QUAIN refer to an anatomical peculiarity in the heart of ruminants and other herbivorous animals, not reported as existing either in man or other mammals. Through the kindness of Mr. MORROW, our President, I had the opportunity afforded me of making a dissection of the heart of a moose, and of examining the bone found in the septum. The heart under examination weighed four pounds twelve ounces, avoirdupois; length from base to apex, 10 inches; circumference at the base, seventeen and one-half inches. Directly at the aortic opening, where the semi-lunar valves are situated, and opposed to the auriculo-ventricular opening on the right side, I found a bony ring, or, more correctly, a section of a circle, measuring one and five-eights of an inch in length. It was roughened on its surface, widest at its centre where it formed an acute process on one side. From the centre it diminished towards the end on both sides, terminating in points tipped with fibro-cartilage. I have since examined many hearts of oxen, and have invariably found this bone in the same situation as in the moose. In size and shape it differs but little from that of the moose.

The quotations above—particularly from OWEN—would point to the presence of this bone as being due to certain pathological changes consequent upon old age in the animals in which it appeared. But a stricter examination will prove that this bone is not a product of decay, due to the deposition of sclerous or a atheromatous matter in the fibro-cartilaginous tissue of the heart. It is a true bone, developed in a situation where its presence serves an important physiological purpose.

A microscopical examination proved it to possess the histological characteristics of bone tissue, there being the lacunæ canaliculi and haversian canals. An atheromatous deposit would, on the contrary, exhibit the deposition of calcareous matter in the fibrous or other tissue without any attempt at organized structure.

The position of the bone renders it an anatomical curiosity. As to its function, I think it serves the purpose of strengthening the aortic opening, maintaining its potency and giving support to the semi-lunar valves. It is a fact in physiology of the heart that the aortic semi-lunar valves will not permit, even under a pressure, sufficient to rupture them, the passage of water from the aorta into the left ventricle, as shown by Mr. J. W. KING'S essay on the safety valve action of the right ventricle of the human heart. (*Guy's Hosp. Reports, 1837. Vol. 11, p. 104.*)

Following the systole or contraction of the ventricles, the mass of blood which had been in their cavities is now in the aorta and pulmonary artery ; distending them, the distension of the arterial walls is followed by their recoil. This would drive it back again into the ventricles, were it not for the sudden closure or shutting back of the pulmonic and aortic semi-lunar valves. The pressure which these valves have to bear is very considerable, equalling that of 6 or 7 inches of mercury in man, and of course a still greater pressure in large animals. In regard to the action of the left side of the heart, the needs of the circulation demand that there shall be no regurgitation or backward flow of the blood. It must go forward, otherwise there is produced serious injury to the capillaries of the lungs and to the systemic circulation, a fact well known to pathologists, as in cases of insufficiency or obstruction in openings of the heart in man.

In large animals, more especially those that are required to put forth efforts of strength or speed, which rapidly increase the blood pressure in the whole vascular system, the increased power of resisting pressure afforded by the partial bony ring at the aortic orifice must be of great consequence, so far as the specific functions of the semi-lunar valves here situated are concerned. It must be observed, also, that the bony matter but partly surrounds the aortic orifice, thereby while giving it strength and resisting power, not interfering with the necessary elasticity of the part. More than this, the solid tissue here in the cardiac septum affords more or less resistancy to the valves in the right side of the heart, preventing, during rapid or forced muscular action, the crowding of too much blood upon the delicate tissue of the lungs.

In the various examinations of hearts which I have made, I have not found the second bone mentioned by OWEN and others.

ART. X.—ON THE WINTER FOOD OF THE PARTRIDGE AND ON PARTRIDGE POISONING. By J. SOMERS, M. D., F. R. M. S., *President.*

THE "Partridge," so-called, *(Bonassa umbellus)* or ruffled grouse, is like its congeners, *Omnivorous,* its food range being what we may term a wide one, embracing, as it does, the products both of the animal and vegetable kingdoms.

In the spring and summer its food consists of insects—*ova larva* or perfected, of molluscs, principally *pulmonata* (snails), and a wee-toad or frog does not come amiss. From the vegetable kingdom various seeds and wholesome berries, in the early autumn the blueberry and huckleberry, *vacciniei,* constitute a staple article of its food; later on the bird subsists principally upon beech mast, and during the months of October and November the crops of partridges secured by sportsmen and others rarely contain any other food. As we advance towards winter the diet of the partridge becomes more and more restricted, and when the season is well established, and heavy falls of snow cover the ground in woods and open, then our partridge is constrained to banquet upon food material that is most within its physiological requirements and nearest to its reach.

At this season the crop of this bird will be found to contain broken catkins of the birch, "*Betula excelsa,*" broken fronds of shield fern, "*Aspidium spinulosum,*" and leaves and berries of sheep laurel, "*Kalmia angustifolia,*" the proportionate quantities being about nine-tenths of birch catkins and one-tenth fern fronds and kalmia leaves, the proportion of the latter, however, always exceeding that of the fern, as you may observe by examining the three partridge crops presented to you; you will notice that the fern fronds are beautifully fresh and green. Having been scratched by the birds from beneath the snow, which preserves them in this condition all through the winter, there is little room for doubt in regard to the reason why the birds seek for and partake of these fern fronds; for though they contain little nutritive matter, they are yet always succulent and tender, and supply them with the only green food which they can procure during our subarctic winter. The kalmia leaves, you will observe, are sear and coriaceous, just as we find them persisting on the plant during autumn and winter.

The birch catkins contain the male flowers of this tree locked up in their winter sleep. They yield, on analysis, both carbonaceous and nitrogenous matter, and supply, though in limited quantity, matters requisite to the nutritive demands of the tissues of our Partridge: but, as they contain, also, a large quantity of insoluble and unassimilable matter, their digestion requires to be slowed, so that the soluble and assimilable matter may be separated and prepared for absorption into the blood. The firm fronds contain a small quantity of starch and mannite, with a percentage of nitrogenized matter; they are probably of most service supplying to the tissues certain inorganic proximate principles which are necessary to their well-being. Salts of soda, potassia and lime abound in ferns. These substances are as much food requisites as those of organic origin.

In birds the nutritive processes and circulation are more rapid than in mammals, their great muscular activity induces rapid tissue change; they, therefore, require a large amount of food. Hence birds are constant feeders. In them, too, the digestive process is quick in action, and a diminution in their food supply is severely felt and soon shows its effects,—they emaciate, lose their activity, and become slow and torpid.

It is well known that birds, considering the size and weight of their brains, are uncommonly intelligent. This applies particularly to the class of birds under consideration, which become proverbially shy and cautious in localities where they are much sought for by sportsmen; in seasons when food is scarce they very often, owing to their diminished activity, become an easy prey to the gun.

In endeavoring to account for the eating of the kalmia leaves by the Partridge, and the innocuousness of this plant to the bird itself, we may premise that it is taken, not for its nutritive value, but because it acts indirectly by preventing tissue change.

It is taken instinctively, no doubt, though not in sufficient quantity to injure it. Kalmia is a narcotic and arterial sedative and contains a large proportion of tannin, it slows the circulation and retards the passage of the food through the alimentary canal. The active narcotic principle in this plant possesses properties similar to those of alcohol, opium, quinia, &c., viz., to lessen tissue change, and thus, in a certain way compensates for a deficiency in the quantity of food.

It may be said that the foregoing ideas are more or less theoretical, but observations into the life history of our Partridge show that in the winter season when there is much snow the food of our bird consists largely of matter, not highly nutritive amongst them and some not usually taken at an earlier part of the season. In the winter they are usually sluggish, and are easily approached by the sportsman. At this time, also, certain portions or the whole of the flesh is often poisonous, producing when eaten symptoms like those that would be caused by the action of a strong arterial sedative, as a subsequent portion of the paper will show.

Hunters' stories are not always credible, yet there is one very common over the Northern portion of our Continent wherever the Partridge abounds, whose universality might answer for its truthfulness. This story refers to the extreme stupidity exhibited by the behaviour of the Partridge at times. It is well known to be shy in early season, but in winter and after heavy snowfalls a covey may be captured when roosting, provided the hunter begins with the birds on the lowest branches.

We could well believe this story if the birds were short of food and under the influence of kalmia, the narcotic action of the plant being well calculated to produce that torpor and want of alertness which is said to characterize the Partridge during the season of snow. This leads up to the second part of my paper, viz., Partridge Poisoning, so-called. I have recently, in my own person, experienced the effects of eating poisoned Partridge, and may mention here that the circumstances and symptoms of my case, which I am about presenting, destroy most effectually the idea that Partridge poisoning is due to idiosyncracy, or to putrifactive changes in the flesh of the bird. These, on the contrary, show that the poisonous property is due to an external cause which, when present, gives always equal results, but when absent there is, as a matter of course, no such results.

The Partridges were four in number,—three were Birch Partridges, *Bonassa*, and one a Spruce Partridge, *Tetrao canadensis*. The crops and gizzards are here before you for examination. The crop of the Spruce Partridge contains leaves of *Abies balsamea* only, the others contain birch catkins, *Betula excelsa*, broken fern fronds, *Aspidium spinulosum*, and leaves of *Kalmia angustifolia*. Nos. 1 and 3 were shot shortly after feeding, as their full crops and empty gizzards testify. No. 3 had the gizzard full, and was, as the specimen shows, in full digestion. This was a fine plump bird, and could be easily selected from the others after they had been all cooked. I beg to direct your particular attention to the gizzard of this bird, the contents of which, at this time (five weeks from when it was opened), develop freely that odour and taste which we call the Partridge flavour. I supposed if there was ever a poisonous Partridge, this must be the one. My surmise proved correct, as the sequel will show. At dinner I partook of this bird, using the black meat and strongly flavored parts, the other members of my family, of which three were children respectively two, five and ten years of age, partook of the white meat of this and of the second birch partridge, none of them experiencing any unpleasant sensations therefrom.

In my own case no results followed partaking of the partridge until about an hour afterwards. I had, in the meantime, gone out, had attended to some business matters, but while doing so became aware that the poison was about to take effect. My first feeling was one of fullness in the brain. A well marked sense of numbness around the mouth and lips and in the fauces. I thereupon returned home, attempted to smoke some tobacco from a pipe but this occasioned nausea, and I was forced to desist. While standing up to set the pipe aside, I was seized with dizziness and inability to maintain the erect position, and would have fallen on the floor of the room had I not supported myself by resting upon a table near at hand, then, by making a strong effort I was able to cross the room to a lounge. On taking the recumbent position, the feeling of dizziness subsided, but the nausea increased until it terminated in copious and prolonged emesis which continued with short intermissions for upwards of an hour. No pain accompanied the emesis which terminated when the stomach was emptied. Accompanying the vomiting there was pain in the back at the root of the neck and between the shoulders, *i. e.* at lower cervical and upper dorsal vertebræ. This was a peculiar kind of pain of a dull aching character, very much like that which follows over-exertion of the muscles. This feeling passed down both arms, but changed from that of pain to one of numbness and tingling most marked along the track of the ulnar nerves, and terminating in the fingers; there existed also a feeling of coldness well marked in both extremities, and felt—though not in the same degree over the whole body—the sensation as if a current of cold air was directed upon the naked surface; the skin was colorless, the face had a ghastly look, perspiration not increased but rather diminished, urine not increased in quantity, no action of the bowels, pupils normal and the intellect not disturbed.

The most marked action of the poison was upon the circulatory system, as the following observations will prove, the action of the heart being slowed, as evidenced by the fall of the pulse.

I should here explain that I am forty years of age, my height five feet nine inches, weight about one hundred and seventy-two pounds avoirdupois, in good health, regular habits, well nourished, normal, pulse about seventy-six beats, respiration to correspond. The first examination of the pulse was made after the first emesis, the time being fifteen minutes past three, p. m., the count gave forty-six beats to the minute. At fifteen minutes to four, p.m.—that is half an hour after the first examination—it had fallen to forty-three beats per minute, the respiration being correspondingly diminished in number. The pulse remained at this figure (43) for about two hours. The emesis continued at longer intervals, being finally overcome by taking small doses of brandy. After six, p.m. no matter was ejected from the stomach. The pulse then began to rise, increasing also in volume, being forty-five at six, p. m. Increasing gradually from that time until seven, p. m., when it counted fifty-eight. The temperature of the surface began to increase with the pulse, and feeling now comparatively recovered from the effects of the poison. I got up and made an attempt to go to the supper table, but was immediately seized with giddiness, and fell on the floor in a state of insensibility, which lasted for a few seconds only, for as soon as I gained the recumbent position the condition passed off almost as speedily as it had occurred, and before assistance could be rendered I was able to help myself to the place I had previously occupied. I then remained in the incumbent position for over an hour, partook of some tea. Was shortly after able to go down stairs to examine and prescribe medicine for a patient who called to consult me, and experienced no unpleasant sensation, except a feeling of languor, some trembling of the muscles, and chillness of the whole body. When I retired to be bed at eleven, p. m., the pulse registered sixty-eight. I slept well. It was not until twenty-four hours afterwards that the pulse resumed its normal beat, and it took three or four days for the system to recover its usual tone.

Partridge poisoning in the human subject has been variously ascribed to idiosyncracy or individual susceptibility to poisonous properties developed by putrefaction or to intaking of food which inoccuous to the bird, yet causes its flesh to assume poisonous properties. Taking my own experience as an example I think we can eliminate the two first causes assigned—the first, idiosyncracy, I can lay no claim to. The Partridge is a game bird for which I entertain a great partiality, and use it frequently when in season. I have eaten the flesh of the bird as freely since as before my poisoning without evil results. In fact up to that time one year ago I had come to believe I was proof against Partridge poisoning, and had some belief in the first theory of causation, knowing that the condition was not of infrequent occurrence in many persons who had eaten this bird. I partook of the black meat and the strong flavored internal parts of my partridge, or the parts that, owing to the presence there of absorbents and the thoracic duct, would contain matters passing from the digestive organs to the blood vessels. The breast of this bird and flesh of other two were eaten by the rest of the household without unpleasant results. I can, however, understand that the whole of this bird would have become poisonous in time. It was killed shortly after feeding, and the poison had not had time to diffuse itself. This will account for the immunity of those who had eaten of the white meat only. The putrefaction theory is out of court also. The bird was quite fresh, as the gizzard and parts before you testifies. More than this, a man in health with good digestion can dispose of flesh in a state of putrefaction with perfect ease. The third then is the only causation to which we can attribute the development of poisonous properties in the flesh of the Partridge at certain times of the year, and I think the facts stated above are sufficient to convince any reasonable person of the correctness of this view, the symptoms exhibited prove the poison to belong to the class of arterial sedatives—said sometimes to be narcotics. The more powerful of the class are not narcotic in the true acceptance of the term. "There was no tendency to sleep in my case." Their action is to depress the circulation by slowing the movements of the heart acting no doubt, through the peneumo-gastric nerves and probably also upon the great splanchnic nerves; there is also arterial contraction and diminished blood in the capillaries, hence the bloodless skin, vomiting, vertigo and loss of consciousness experienced in this case.

An extract from a memoir of Dr. Stabler in Griffith's Medical Botany, p. 429 says, a large dose of a strong decoction of *Kalmia latifolia* caused in half an hour vertigo, dimness of sight, great depression of the heart's action and cold extremities, without, however, producing any disorder of the mental faculties. It is said in the same work, on the authority of Dr. B. S. Barton, the American Indians used the plant for suicidal purposes. The symptoms of Kalmia poisoning given by Stabler coincide so closely with those of Partridge poisoning we are safe in assuming that they are due to one and the same poison. It is also conceded from a therapeutical point of view that Kalmia Angustifolia is more active than *K. Latifolia,* the former plant being the one found in the stomachs of our Partridges during the winter season.

APPENDIX.

A Supposed Deep-Sea Fish.

Our fish was found at Cole Harbor Dyke, east of Halifax, early in January, and exhibited in the city on the 16th and for some time after. It had been thrown ashore during a storm. Unfortunately, the fish was not preserved in the form in which it was found. It was roughly skinned and the carcass was thrown away, so that a great part of its scientific interest is gone. Having never seen any fish like it, I was puzzled to characterise and name it. It was taken away and I never expected to see it again. In the meantime its general form, with the tentacles on its head, suggested an affinity with the *Lophius piscatorius.*

A description of it given by the owner, Mr. Main, in the Halifax newspapers, led Prof. Baird to make enquiry after it with a view to purchase it. He suggested that it might be a *Himantolophus.*

On referring to "Gunther's Introduction to the Study of Fishes," I found the description of this deep-sea fish. It seemed to agree in many points with the appearance of the fish, while at the same it differed. It is now a specimen in the collection of the Provincial Museum. I have set it up in better form. In doing so I have at the same time studied its character, and come to the conclusion that it is more nearly allied to *Ceratias* than *Himantolophus.* I quote "Gunther's" definitions of both:

"Twelfth Family—Pediculati.

"Lophius—*Lophius piscatorius.*

"Ceratias: Head and body much compressed and elevated; cleft of the mouth wide, subvertical; eyes very small; teeth in the jaws rasp-like, depressible; palate toothless; skin covered with numerous prickles. The spinous dorsal is reduced to two long isolated spines—the first on the middle of the head, the second on the back. The soft dorsal and anal short; candal very long; ventral, none; pectorals very short; two and a half gills; skeleton soft and fibrous.

"*Ceratias holbolli*"—a deep-sea fish. Only a few examples have been found near the coast of Greenland and from the mid-Atlantic, the latter at a depth of 2,400 fathoms. Deep black.

"HIMANTOLOPHUS.—Head and body compressed and elevated; cleft of the mouth wide, oblique; eyes very small; teeth of the jaws rasp-like, depressible; palate toothless; skin covered with conical tubercles. The spinal dorsal is reduced to a single tentacle on head. The soft dorsal and caudal and pectoral short. Ventrals, none. Three and a half gills. Skeleton soft and fibrous.

"This is another deep-sea form, hitherto found in very few examples in Arctic and mid-Atlantic ocean. The single tentacle is beset with many long filaments at its extremity, thus answering the same purposes which is attained by a greater number of tentacles. Deep black."

I now give the dimensions of our fish, with remarks:

	feet.	in
The length from snout to caudal fin is..........	3	
The depth of the body is....................		9
The girth is..............................	2	
Head—from snout to gill opening, the length is..		9
The mouth is open. Its vertical measurement...		3½
Its width is..............		2½
The eyes are small. Interorbital space is.......		4

Teeth in the jaws rasp-like, depressible. Skin covered with numerous prickles (conical tubercles), a few pointed, the greater number truncated with perforations in the tops. The sides of the head and its inferior part have only a few. The spinal dorsal is reduced apparently to one long isolated spine on the head. On the back is a space without tubercles, having the skin, so as it might have accommodated another spine of some sort.

The *dorsal fin* has a width of .... 6 in.
It has four rays—the length of the 3rd and 4th is 4 "
The *anal fin* has a width of .... 2½"
It has four rays—the largest is................ 4 "
The caudal fin is long and broad; the length of
the upper ray is .... 9 "
of the lower.......................... 8 "

It has eight rays, the four middle ones are *dichotomous*. They are broad and coated with flesh, etc. Skin having prickles and tubercles. It is sometimes hard to convince our fishermen that the tubercles are not *barnacles.* The fin rays have, not unaptly, been compared to coral branches.

The width of the *caudal fin* is from 7 to 8 inches.

There are no *ventral fins.*

The pectorals are very small, being $1\frac{1}{2}$ x 1 inch each.

The number of rays is 18.

They are situate *above* (not after) the gill openings. They thus *seem* to have an anomalous position.

These pectorals are so widely different from those of the *Lophius piscatorius* and seem to exclude our fish from the family *Pediculati.*

What remains of the integument of the fins is black.

There is a spiracle at the back of the tentacle. The gill openings are two in number. If they had opercles these have been destroyed.

Shrinkage may have reduced the orginal dimensions.

The color now is blackish brown. It was much darker when I first saw it.

D. HONEYMAN,

March 25, 1884. *Curator of Provincial Museum.*

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. VI. PART II.

Provincial Museum, October 26, 1883.

ANNIVERSARY MEETING.

ROBERT MORROW, F. R. M. S., *President, in the Chair.*

INTER ALIA.

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

President,—ROBERT MORROW, F. R. M. S.

Vice Presidents,—JOHN SOMERS, M. D., WILLIAM GOSSIP, ESQ.

Secretaries,—REV. D. HONEYMAN, D. C. L,, F. R. S. C., &c.

ALEXR. MCKAY, Supervisor Public Schools.

Treasurer,—W. C. SILVER, ESQ.

Council,—WM. H. HARRINGTON, AUGUSTUS ALLISON, SIMON D. MACDONALD, F. G. S., MARTIN MURPHY, C. E., JAMES R. DEWOLF, M. D., EDWIN GILPIN, F. R. S. C., &c., J. G. MACGREGOR, D. SC., F. R. S. C., &c., GEORGE LAWSON, Ph. D., LL. D., F. R. S. C., &c.

ORDINARY MEETING, Nov. 12, 1883.

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

A Paper was read by WM. GOSSIP, Esq., delegate to the Royal Society of Canada, giving an account of his visit to Canada, and of proceedings of the R. S. C.

A Paper by EDWIN GILPIN, F. G. S., Inspector of Mines, "On the De Bert Coal Fields," was read by the Secretary.

ORDINARY MEETING, Dec. 12, 1883.

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

DR. HONEYMAN, by request, read a Paper entitled "Natural History of the Canadian Department of the Great International Fisheries Exhibition, London, 1883."

ORDINARY MEETING, Jan. 1884.

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

A Paper was read by EDWIN GILPIN, F. R. S. C., &c., "On Manganese Ores of Cape Breton."

J. G. MACGREGOR, D. Sc., read a Paper "On two Special Auroræ."

A Paper was also read by GEORGE LAWSON, Ph. D., LL. D., F. R. S., &c., "On the Northern Limits of Indigenous Grape Vines."

ORDINARY MEETING, Feb. 11, 1884.

J. J. FOX, Esq., *in the Chair.*

A Paper was read by SIMON D. MACDONALD "On Sable Island—its changed position," &c.

ORDINARY MEETING, March 10, 1884.

MARTIN MURPHY, C. E., Vice President, *in the Chair.*

DR. HONEYMAN read 2 Papers :

1. "On Glacial Action at Rimouski, Canada, and Loch Ech, Argyleshire, Scotland.

2, "Notes on Polariscopic and Microscopic examinations of Crystalline Rocks of Nova Scotia and Cape Breton."

ORDINARY MEETING, April 14, 1884.

WM. GOSSIP, Esq., Vice President, *in the Chair.*

M. MURPHY, C. E., was elected a delegate to the Royal Society of Canada.

A Paper was read by M. MURPHY, C. E., "On some Physical Features of Nova Scotia, with Notes on Glacial Action."

ORDINARY MEETING, May 12, 1884.

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

A paper, "Notes on Our Fresh Water Sponges," by A. H. McKay, B. A., B. Sc., Principal of Pictou Academy, was read by the Secretary, Alexander McKay, Esq.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11—Akins, T. B., D. C. L., Halifax.
69. Feb. 3—Allison, Augustus, *Meteorologist*, Halifax.
77. Dec. 19—Bayne, Herbert E. PH. D., F. R. S. C., *Professor of Chemistry, &c.*, Royal Military College, Kingston, Ont.
84. Mar. 13—Bowman, Maynard, *Public Analyst*, Halifax.
64. Dec. —Brown, C. E., Halifax.
63. Oct. 26—DeWolfe, James R., M. D., L. R. C. S. E.
82. May 8—Fox, John J., Halifax.
78. Jan. 30—Geldert, J. M., *Barrister*, Halifax.
73. Apl. 11—Gilpin, Edwin, F. G. S., F. R. S. C., *Government Inspector of Mines.*
63. Jan. 5—Gilpin, J. Bernard, M. D., M. R. C. S., F. R. S. C.
63. Feb. 5—Gossip, Wm. *Vice-President*, Halifax.
63. Feb. 5—Downs, Andrew, M. Z. S., *Taxidermist*, Halifax.
83. Mar. 12—Forbes, John, *Starr Manufacturing Co.*, Dartmouth.
63. Mar. 12—Foster, James G., *Barrister*, Dartmouth.
81. Dec. 12—Hare, Alfred, Bedford.
82. Apl. 10—Harrington, D., M. D., Halifax.
67. Dec. 3—Honeyman, Rev. Dr., D. C. L., F. R. S. C., F. A. S., &c., *Secretary, Curator Provincial Museum*, Halifax.
74. Dec. 10—Jack, Peter, *Cashier of People's Bank*, Halifax.
63. Jan. 5—Jones, J. M., F. R. S. C., F. L. S., Berwick, N. S.
82. Apl. 10—Keating, E. H., C. E., *City Engineer*, Halifax.
64. Mar. 7—Lawson, G., PH. D., LL. D., F. R. S. C., F. C. I., *Professor of Chemistry and Mineralogy, Dalhousie College*, Halifax.
81. Mar 14—Macdonald, Simon D., F. G. S.
77. Jan. 13—MacGregor, J. G., D. SC., F. R. S. E., F. R. S. C., *Professor of Physics, Dalhousie College*, Halifax.
72. Feb. 5—McKay, Alex., *Secretary, Supervisor of Halifax Public Schools.*
78. Nov. 1—McLeod, John, Demerara, West Indies.
77. Jan. 13—Morrow, Geoffrey, Halifax.
72. Feb. 10—Morrow, Robert, F. R. M. S., *President*, Halifax.
70. Jan. 10—Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
79. Dec. 14—Neal, W. H., Halifax.
65. Aug. 19—Nova Scotia, the Right Rev. Hibbert Binney, *Lord Bishop of*
79. Nov. 11—Poole, H. S., ASSOC. R. S. M., F. G. S., *Supt. Acadia Mines*, Pictou.
76. Jan. 20—Power, Hon. L. G., *Senator*, Halifax.
71. Nov. 19—Reid, A. P., M. D., *Superintendent of Provincial Lunatic Asylum*, Dartmouth.
65. Jan. 8—Rutherford, Jno., *Superintendent of Albion Mines*, Pictou.

64. May 7—Silver, W. C., *Treasurer*, Halifax.
75. Jan. 11—Somers, John, M. D., *Professor of Physiology and Zoology*, *Halifax Medical College.*

ASSOCIATE MEMBERS.

82. Oct. 1—Gunn, John G., *Inspector of Schools*, Cape Breton.
81. Nov. 13—Harris, C., *Professor of Civil Engineering*, *Royal Military College*, Kingston, Ont.
76. Nov. 9—Kennedy, Prof., *King's College*, Windsor, N. S.
71. Jan. 11—McKay, H. A., B. A., B. C., *Principal of Pictou Academy.*
82. Mar. 31—McKenzie, W. B., *Engineer*, Moncton, New Brunswick.
83. Mar. 12—McKenzie, O. H., M. D., *Inspector of Schools*, Parrsboro.
78. Mar. 12—Patterson, Rev. G., D. D., New Glasgow.
84. Apl. 4—Pineo, A. J., *Editor of Canadian Science Monthly*, Wolfville, N. S.

CORRESPONDING MEMBERS.

71. Nov. 29—Ball, Rev. E., Tangier.
71, Oct. 12—Marcou, Jules, Cambridge, Mass.
80. June 10—McClintock, Sir Leopold, Knt., F. R. S., *Vice Admiral.*
77. May 12—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.—NOTES ON THE DEBERT COAL FIELD, COLCHESTER CO., N. S. BY EDWIN GILPIN, JR., A. M., F. G. S., F. R. S. C., *Inspector of Mines.*

(Read 12th Nov., 1883.)

DURING the past few months a good deal of interest has been shown in Mining circles over the reported discoveries of coal seams, of workable size, on the DeBert River, Colchester Co. In this conclusion the following notes of a brief visit to the ground may prove interesting to the members of the Institute, and I only regret that the attention necessarily directed to mines in operation has prevented me from giving more time to the problems presented by this practically unknown district.

The presence of coal beds on the DeBert and Chiganoise Rivers has long been known to the geologist. Gesner, one of the pioneers of Nova Scotian Geology, writing in 1836, described the signs of coal at various points along the north side of the Basin of Minas, from Cape Chignecto to Truro, and remarks, page 129 of his " Geology and Mineralogy of Nova Scotia," that " About five miles northward of the Lower DeBert bridge the coal measures of the mountains rise above the gypseous and saliferous sandstones, and a beautiful section of their strata is made by the river passing over them. Two small veins of coal have been intersected, although it is not known what quantity of that valuable substance is still hidden in the adjacent rocks."

Dr. Dawson, in the second edition of his Acadian Geology, page 264, speaks of the metamorphic slates of the Cobequid Mountains being succeeded by conglomerates, and then by " coal measure rocks, consisting of gray sandstones and dark shales, and a few thin seams of coal, and abundance of leaves of cordaites, and a few calamites and stigmaria."

He further remarks: "We can trace this coal measure back from Advocate Harbour, near Cape Chignecto, to the upper part of the Salmon River of Truro, where it adjoins the carboniferous district of Pictou. It is (generally speaking) much broken and disturbed; and although it widens considerably towards its eastern extremity, it nowhere attains a great development, either in horizontal extent, or in the magnitude of its coal seams." From Advocate Harbour to Partridge Island the belt contains contorted shales and sandstones yielding a few fossil plants, scales of fishes, and shells of Naiadites. Mr. Matthew Jones, a member of this Institute, some years ago found in these strata footprints of a large reptilian animal, referable to the genus sauropus. Similar shales and sandstones outcrop on the banks of the various rivers falling into the Basin of Minas, and show beds of bituminous limestone, with cyprids and fish scales, fireclays, clay ironstones, etc., and yield characteristic fossil plants of several of the species found in the Joggins section.

In the same work Dr. Dawson has discussed the physical conditions which governed the deposition of the coal and associated carboniferous measures of the district. The evidence of the foldings of the carboniferous of the north side of the Basin of Minas, plainly given by the various river sections, leads to the anticipation that the coal measure band may prove disturbed. The longitudinal foldings are useful to the prospector, as they bring the various coal crops to the surface, and define the limits within which his researches can be carried on with profit. The transverse folding and faults caused by unequal strains, and by the irregularity of the great mountain chain, the determining element, may prove a source of expense to the miner engaged in economic development.

The upper DeBert bridge, on the Londonderry road, appears to be a little to the south of the centre of the Basin in this locality. Following the stream downwards from the bridge the coal beds appear about in the relative order of the section, which is descending geologically speaking:—

	Ft.	*In.*
Strata	200	9
Coal seam	2	6
Strata	120	0
? Coal seam (so-called "nine feet")	9	0
Strata	30	0
Coal seam	2	0
Strata	140	0
Coal seam	6	0
Strata	100	0
Conglomerate, base of section.		
Total	609	6

The first seam met is one on the west side of the River, and it is stated to measure about 2 ft. 6 in. of coal. The nine feet seam, so-called, had not been opened at the time of my visit, and the thickness is that given by the man in charge of the boring. The seam below this is exposed on the west bank of the river, nearly on the line of the seam just referred to as being nine feet thick.

The six feet seam was opened last winter by a short slope, and about 50 tons of coal were extracted. It is stated to have in the centre a band of shaley coal about 9 inches thick. I was unable to verify the dimensions by actual measurement, as all the openings were full of water at the time of my visit, but the outcrop of the bed under the waters of the river apparently confirmed them.

The coal looked unusually well for a crop exposure, and samples selected to form an average gave the following results :—

Coal compact. Cleavage planes very obliquely inclined to each other. Fractures of the coal presented a conchoidal and lustrous appearance. The deposition planes showed a good deal of mineral charcoal. The coal is laminated with numerous bright pitchy layers up to one-half of an inch in thickness. A few films of calc-spar showed in the cleavage planes, and there was very little visible pyrites. Powder dark reddish brown.

ON ANALYSIS *(by fast coking.)*

Hygroscopic moisture	1·594
Volatile combustible matter	33·188
Fixed carbon	58·206
Ash	7·012
	100·000
Sulphur	2·648

Coke fairly coherent.

From this analysis it will appear that the coal, although holding more sulphur than is usually found in the coals of Nova Scotia proper, is of good quality, and similar in general composition to that mined at Spring Hill.

About 100 feet below the 6 feet seam is a bed of conglomerate, having a dip to the north similar to that of the section given above. The conglomerate appeared to be about 150 feet wide on the river, and to grow broader to the westward. Where exposed on a small brook about ⅓ of a mile west of the river, it presented a double dip S 5° W and N 10° W, apparently forming the saddle of an anticlinal, and was overlaid to the south by gray shaley sandstones dipping S 5° W and at an angle of 25°.

On the north side of the conglomerate, on the brook, at about the same distance from it as the so-called nine foot seam is on the river, an imperfect exposure of coal is met presenting the following section:—

	Ft.	In.
Coal, with shaley bands	2	0
Fireclay	2	2
Coal, good	0	10
Total	5	0

About 100 feet further up the brook a four feet seam of coal is said to have been proved by a bore hole.

About 100 yards above the bridge is an exposure of measures holding a seam of coal about 18 inches thick, and running nearly at right angles to the course of the seams already described. From this it would appear that the beds exposed on the river are at the eastern apex of a subordinate basin formed by transverse folding.

Should further research show that at this point the seams referred to maintain their size, and extend in a form permitting of economic exploitation, the discoveries are of great importance. The search for similar seams may then reasonably be made at other points along the coal band, and certainly the areas of the Minas Basin coal field is large enough to allow a hope that in the future it may be added to the list of our productive districts.

Art. II.—Notes on the Manganese Ores of Loch Lomond, C. B. By Edwin Gilpin, A. M., F. G. S., F. R. S. C., *Inspector of Mines.*

(Read 14th Jan., 1884.)

For a number of years the presence of these ores in Cape Breton was recorded cnly by the mineralogist. Recently, however, deposits of economic value have been found and worked. The ores of manganese occur, in Nova Scotia proper, in strata of Lower Carboniferous age, occupying a horizon low down in the Marine Limestone formation. The late Dr. How, in a paper read before this Institute some years ago, gave an interesting account of these minerals as they occur and are worked in Hants County. This evening I purpose merely to draw the attention of the Institute to their occurrence in Cape Breton, an interesting fact, as the knowledge of their presence in workable amounts in the Loch Lomond district will lead to a search for them in other parts of the Island. In all probability, the wide extent of the Cape Breton Limestones will before long afford several localities containing deposits worthy of the miner's attention. My notes are from a visit to the mine, and from information kindly furnished me by Mr. Fletcher, of the Geological Survey of Canada, who made a detailed survey of this district summer before last. The geological features of this part of Cape Breton are represented by a band of millstone grit extending from Mira River, up the Salmon River, to Loch Lomond; and bounded on the north by the felsites of East Bay, and on the south by the felsites of the Mira Hills. At several points the Lower Carboniferous marine limestone formation crops out beneath the millstone grit, and occurs as isolated patches resting directly on the felsites, and there are patches of the basal carboniferous conglomerates brought up by faults through the millstone grit.

The locality in which these deposits have been discovered is on the Salmon River Road, about two miles east of Loch Lomond, near the line dividing Cape Breton and Richmond Counties.

The felsites formed a shore along which we now find limestones, conglomerates, shales and grits exposed as they were accumulated under the varying conditions of current, depth of water, and of the prevailing winds of the period under consideration. At some points the limestones rest on the felsites, at other points conglomerates and shales intervene. The discoveries of manganese ores, more particularly the subject of my paper, were made in one of these bays, where the felsites are succeeded by shales, grits, conglomerates, and finally by limestones, the latter extending apparently from point to point of the ancient Bay.

The manganese ores are found at the Western, or McCuish Mine, in irregular bedded layers in a soft arenaceous shale, which is in places calcareous, and coated with manganese oxide The layers vary in thickness up to 18 inches, and are sometimes connected by vertical stringers of ore. The shales when weathered present nodules of ore, and large quantities are present as films on the cleavage planes of the shale.

At the Eastern, or Morrison mine, the ore at the time of my visit was mined from a bed underlying a thin layer of black manganiferous limestone, with red and greenish shales and sandstones and conglomerate. The thickness of the ore and of the limestone varied from 2 to 8 inches. The average thickness of the two layers being 8 inches.

The ore was found at several other points in the vicinity as lenticular masses and irregular nests in conglomerate, etc., and sometimes forming the cementing material. This latter mode of occurrence is similar to that shown by the red hematites found in the lower carboniferous conglomerates at several parts of the island near their junction with older strata. And near the Loch Lomond post office a highly manganiferous red hematite occurs under conditions apparently of a similar nature.

The limestone overlying these measures is highly manganiferous and ferriferous, and contains numerous crystals of galena, which some time ago incited prospecting, as they were thought to be silver ore.

The ore from the Western, or McCuish mine, is a fine-grained pyrolusite, sometimes holding a little brown, or hard ore. It is generally amorphous, but the better grades show a subcrystalline structure. The McCuish ore is a soft black amorphous ore, apparently of high order. At several points considerable masses of lenticular hard ore are met, with calcspar and heavy spar. The minerals associated with the ore are calcite, baryte and limonite.

The following analyses by Mr. G. C. Hoffman, Analyst to the Geological Survey, will show the character of the ores:—

Sample No. 1.—Pyrolusite with a little manganite, gave—

Binoxide	81·52	per cent.

Sample No. 2, consisting almost exclusively of pyrolusite, gave

Binoxide	88·98	per cent.
Ferric oxide	·21	" "

Ores represented by the above analyses would be adapted for all uses to which the mineral is usually put, and especially to glass making.

As the extent of manganiferous ground is considerable, and the quality good, it is to be hoped that these ores will form a permanent addition to the list of Cape Breton exports. Up to the close of the year 1883 about 200 tons have been shipped.

These ores have been worked by Mr. E. T. Moseley, who deserves credit for having inaugurated a new mining industry in Cape Breton County.

Art. III.—Note on Peculiar Auroræ. By Prof. J. G. MacGregor, D. Sc.

Two auroræ which I observed during the past summer exhibited a peculiarity of form sufficiently interesting to warrant my drawing the attention of the members of this Society to it.

The first was observed at Halifax on the 31st July. It had the form of a bow stretching across the sky from the east to the west point of the horizon and through a point a few degrees south of the zenith. The bow was about five degrees in width. No rayed structure could be traced in it, and its light during the greater part of its duration was very nearly uniform throughout, the whole luminous area, except at the edges of the bow, where the luminosity diminished rapidly outwards. The bow was visible from 10 to 10.30 o'clock, p.m. Towards the end of that time the east and west ends grew more faint, and the diminution of luminosity gradually extended from the ends towards the zenith. In about 15 minutes from the time at which this diminution began the bow had entirely vanished. The sky was quite clear and there were no clouds. I was unable to determine the spectrum of the bow.

The second aurora mentioned above I observed at New Glasgow, N. S., on the evening of September 5th. It had the form of a bow of the same width as the other, stretching from a point about 30° north of west to a point about 30° north of east through the zenith. It had at first a slightly marked rayed structure in the direction of its length, but this structure gradually vanished, and rays then appeared crossing the bow so as to make angles of about 45° with the direction of its length. It lasted also from about 10 to 11.30 o'clock, when it faded away, the ends fading first, and the portions near the zenith widening before disappearing. One of Hilger's larger pocket spectroscopes shewed that its spectrum consisted of two lines in the green, one bright, the other faint, and at times invisible. The sky was clear. No auroral lines were seen in the spectrum when the instrument was directed to other parts of the sky than that occupied by the bow.

ART. IV.—ON THE NORTHERN LIMIT OF WILD GRAPE VINES. BY GEORGE LAWSON, PH. D., LL. D.

Read 14th January, 1884.

I LATELY received a letter of enquiry from Professor Blytt in reference to the Northern Limit of the Grape Vine, as bearing upon the early discovery of America by Norwegian sailors. As the exact range of our wild grapes had not been made a special subject of enquiry by botanists, and as these plants, wherever they occur, are so conspicuous as to attract the attention of persons who might overlook other plants, I requested publication of a note, for the purpose of eliciting information, in the Halifax *Morning Chronicle*, *Morning Herald*, and *Acadian Recorder*. This brought some facts which will be found in the following correspondence. It is now published in the hope that additional information may be obtained. It is not improbable that the range of Grape Vines along the Atlantic Coast region was more extensive before the country was settled than it is now, when the best lands are cleared and the country pastured by cattle. Any information on this point from old records or reliable tradition would be of special interest.

AMERICAN SPECIES OF VITIS.

The proper Grape Vine (*Vitis vinifera*) is believed to have been originally a native of the hilly region on the southern shores of the Caspian Sea, and of the Persian province of Ghilan ; but it has been cultivated by man from the earliest times of which we have record, and has thus been extensively distributed over the world. It was not known, however, on the American Continent before the settlers from Europe had brought it with them. Nevertheless early voyagers speak of finding Wild Grapes on landing on the American shores. These so-called Wild Grapes are vines very distinct in character from the old-world Grape Vine, but they nevertheless consist of species of the same genus *Vitis*, several of which bear, even in the wild state, clusters of well-flavoured grapes, whilst the fruit of other kinds is acid or mawkish.

V. bipinnata, which extends through Virginia to Georgia and west to Arkansas, has a globose depressed berry, size of a pea, blackish when ripe.

V. indivisa grows in the swamps of the Southern States, west to Louisiana and Arkansas, bearing a very small, usually one-seeded berry.

V. æstivalis, the Summer Grape, grows from Connecticut to Florida and west to Arkansas, ripening its blue, pleasantly-flavoured berries in October; original of the Clinton Grape.

V. vulpina, or Fox Grape of the South, grows in Virginia, Florida, and intervening States.

V. incisa is a Prairie Plant confined apparently to Texas and Arkansas, and has black shining berries the size of a small pea.

V. cordifolia and *V. riparia*, which are more northern in their range, have acid fruit, which sweetens after having been touched by frost, hence they are commonly called Winter Grapes to distinguish them from *V. æstivalis*, the fruit of which becomes sweet as it ripens in the sun. *V. riparia* is said to be the original of the Delaware and Taylor-Bullet grapes.

V. Labrusca, is one of the best known species which has very large leaves, and is familiar to us in its garden forms as the Isabella, Catawba, and several other well-known American grapes. Varieties of this species are distinguished by the hairiness or woolly character of the very large leaf, and comparatively large berries.

CANADIAN SPECIES.

Only three species of *Vitis* extend into Canada, viz., *Labrusca*, *cordifolia* and *riparia*.

V. Labrusca; leaves (thick 5-7 inches) broadly cordate angular, more or less lobed, the sinuses obtuse or rounded, the under surface tomentose; berries, large globose.

V. cordifolia; leaves (thin, 3-6 in.) cordate acuminate, toothed, smooth (except on the veins), berries small.

V. riparia; leaves (thin 4-6 inches) more or less deeply divided into three lobes and incisely toothed; smooth, except on the petioles, veins and margins, which are pubescent; berries small.

V. LABRUSCA, *Linn.* Canada.—*Pursh, Torrey & Gray.* Near the Falls of Niagara.—*Provancher.* Extends south to Georgia and west to Arkansas and Texas.

Torrey speaks of the fruit of the wild plant as having a strong disagreeable flavour, whilst when cultivated "it is as pleasant as any of the varieties of *Vitis vinifera.*" In Hooker's Flora (published so long ago as 1833) it is remarked that "two sorts are much esteemed at New York, and known under the name of 'Bland's-grape' and the 'Isabella-grape.'"

V. CORDIFOLIA, (*V. vulpina*, of Hook.) Shores of Lake Ontario west from Kingston; several places on the banks of the St. Lawrence, as at Thousand Islands, Brockville, La Chine, etc. Extends south through the United States to Florida and west to Arkansas.

V. RIPARIA, *Mich.* Canada.—*Mr. Cleghorn, Mrs. Percival.* Lake Huron.—*Dr. Todd*, extending to the south end of Lake Winnipeg in lat 50 degrees N., (Hook. Fl. B. A.)

Nicolet, P. Q., and Malden Ont.—*Dr. P. W. Maclagan.* Belleville, common, especially along streams.—*J. Macoun.* L'isle-aux-Coudres.—*Provancher.* Some of the localities may belong to *V. cordifolia.* Extends through the Uuited States south to Virginia and west to Arkansas.

Without specimens from the several localities, or careful determinations made on the spot by competent botanists, it is impossible to assign with certainty to their proper species the stations quoted for *V. cordifolia* and *V. riparia.* Dr. Englemann made a very careful examination of the distinctive characters of the N. American species of Vitis, and characterized *V. riparia*, as differing from its ally as follows:—"Leaves larger, usually incisely three lobed, the lobes long-pointed; panicles small, rather simple; berries larger and mostly with bloom; seeds larger, obtuse and somewhat obcordate and with an inconspicuous raphe. May, earlier than the allied species."—See Gray's Manual, fifth edition, eighth issue,—Addenda, p. 679 (January, 1868). *V. cordifolia* "has the berries black without bloom, the small seeds rounded above and with a prominent raphe."—*Englemann.*

" *V. cordifolia* or *riparia*, grows, on the evidence of collections made on my former journeys, as far north as the south end of Lake Winnipeg, on the 50th parallel. I did not observe it on my late voyage, in which, indeed, I had very little leisure to search for plants, and, if it actually grows in so high a latitude, it does not produce edible fruit so as to attract the attention of the residents, who could give me no information respecting it. It is common in Wisconsin and Minnesota, with *V. æstivalis.*"—Sir J. Richardson; Arctic Jour., II., p. 287.

CHRISTIANIA, NORWAY, 5th JULY, 1883.

Dear Sir,—My friend, Mr. J. Storm, professor of history at our university, wishes to know how far north on your coasts the wild species of Vitis (V. vulpina, Labrusca, &c.,) grow. I cannot make it out for him with the books at my disposal, so I am obliged to turn to you and trouble you with the matter. You would oblige me and my friend very much if you would be kind to let me know the northern limit of the species above mentioned in your coast districts. America was discovered some 1000 ago by Norwegian sailors, who found wild grapes at the shores and named the country after them "Vineland," which means the country of wine.

With much respect, yours,

A. BLYTT,

Professor of Botany at the University.

The Honorable Judge Ritchie informs me that, when a boy, he frequently gathered wild grapes between Annapolis Royal and Bear River, and that he has no doubt he could still find the place where the vines grow.

Professor Macdonald informs me that our esteemed President, Robert Morrow, Esq., before leaving for the South, stated that he had seen a Wild Grape vine growing in a garden at Stellarton, in Pictou County, and was told that it had been brought from the neighbouring woods. Some years later, at a distance of several miles further up the East River, he found the Grape growing wild.

My dear Professor Lawson,—In relation to your enquiry respecting Wild Grapes, I have a recollection of past days that may suggest a quarter in which that enquiry may be successfully prosecuted.

Many years ago I lent the late Judge Haliburton an interesting book that I in vain have often endeavoured to recover. Reclamation of it is hopeless now! The author was a *Netherlander* of intelligence, who particularly mentioned an indigenous grape seen and *noted by him, of which the locality was the neighbourhood of Annapolis.*

Perhaps it might be worth your while to direct the proposed enquiry to some old inhabitant of the old French capital.

Yours ever truly,

Windsor, 9th Dec., 1883. L. M. WILKINS.

My recollection of the book and the fact referred to is distinct and you may regard it as reliable. The book was found by me among those of the Thomas family, by some of whom it was brought from Marshfield, Mass.—the ante-Revolution seat of that family—about the close of the last century.

The discovery of the author would antedate the beginning of this century.

L. M. W.

There is little doubt, I think, that a copy of the book in question is slumbering on the shelf of some Boston library. The author was not a mere traveller, but came to America on some mission for his Government.

I add a circumstance that may serve to identify :—The Book—probably on authority of a redman—indicated *phonetically* Niagara thus :—"Nee-a-gaw-raw."

Windsor, Dec. 11th., 1883. L. M. W.

BRIDGEWATER, 11th DEC., 1883.

Dear Sir,—A young Norwegian Captain just left here for Spain, told me some of their professors were to visit our land, as he put it, in search of marks made by their countrymen long since, and a few days after I noticed in the papers that you had been consulted on the matter. My object is to let you know that there is a large rock sitting on three legs of stone, of the height of 18 inches, which I believe was put up by these old cruisers. It sits on Indian Point, near the County line between this and Queen's County. I met with it when a child, and have taken great interest in it; have frequently visited it as it puzzled me, till of late years. Should you meet those people, if you think well of it, they may easily drive to it now, but not when I used to steer my boat to where it sits. It is plainly seen from entrance of the port. Locality, Indian Point, Port Medway Harbour, Queen's County.

Respectfully yours,

E. D. DAVISON, SR.

See article on Oak Canoe, in *Scientific American*, Dec. 8th. I have a stone axe by which one could make quite a job at big work.

Just received a note from a friend informing of his having three stone relics, and I have quite a number, all from the Port Medway river, whilst nothing of the sort can I find about the LaHave River, but have two iron axes found in old graves, one having been buried at Wentsill's Lake, where bones and axes were wrapped in birch-bark.

There is an old burying ground and koche for dried salmon, &c., I expect. E. D. D.

HALIFAX, N. S., DEC. 8th., 1883.

Dear Sir,—In answer to your question about "Wild Grapes," a small sized wild grape grows in abundance on some of the islands in the St. John river, about seven miles above Fredericton, N. B. I have drank the wine made from them and it is very good.

Any more information I can give, will only be too happy to do so, and remain, Sincerely,

ALEX. IRVINE KARNEY,

International Hotel, City.

In a subsequent letter Mr. Karney observes that Mr. Michael Mitchell, Scotch Settlement, York Co., New Brunswick, is owner of the island where the grapes grow.

LIVERPOOL, N. S., DEC. 10th, 1883.

Dear Sir,—There is a grape vine said to be a wild one growing on the farm of a Mr. Hall, on the other side of Allen's Creek, close to the town of Annapolis.

I have seen and was told it was a wild one, but it may be a degenerate vine planted by the French. Seeing your letter in the *Chronicle* of the 8th inst., I thought well to mention this one. I am very intimately acquainted with the province of Nova Scotia, but do not know of any other wild vine.

Yours, &c.,

MAX D. MAJOR.

"SAINT JOHN GLOBE," EDITOR'S ROOM,
Saint John, N. B., Dec. 10th, 1883.

Dear Sir,—Wild grapes are not uncommon along the St. John River.

At Fredericton I know of several vines in gardens, which were transplanted from the woods, and some of which have seeded themselves.

Yours,

JOHN ELLIS.

ANNAPOLIS ROYAL, DEC. 10th, 1883.

Dear Doctor,—Answering your enquiries in the newspapers, I beg to inform you that I have known a wild grape vine within a mile or more of this town. In a ravine whose steep sides prevented culture, it flourished. It was surrounded by cultivated fields, cultivated no doubt by the French, before Nicholson's capture, a mile or more from the steep hills, now as then covered by the forest primeval.

It was very luxuriant, and, though I do not recollect eating the grapes, yet its flowers and half ripened berries I well remember. It was an object of curiosity to me, especially as proving the exactness of old LesCarbot, our most exact and homeliest historian. *Without knowing,* I thought it the little Fox Grape so luxuriant on the warm south side of New England and which as a boy I knew so well—very thick skin and very tart flavor. I have no doubt it still exists, but the snow would cover it now. I hear of many other vines about here, but this is the only one I have personally seen. If you want more knowledge let me know and next spring I could send you a specimen.

B. GILPIN.

ST. JOHN, N. B., 10th DEC., 1883.

My Dear Sir,—I notice your communication in Saturday's *Chronicle* regarding the "Wild-Grape" and its Northern Limit. Some years ago I was puzzled over the statement, in Demont's account of the discovery of the St. John River, that they noticed (in June 1604 or 5) grapes growing in profusion on its shores. For some time I was under the impression that they had mistaken some other vine for that of the grape. But I found afterwards that in fact the wild grape does grow in several places on the River St. John,—on the sandy points along its south-westerly bank at Westfield in King's County,—luxuriantly on some islands near Oak Point known as "Caton's Islands,"—a little further up and beyond this on the islands Oromoeld and Prince William. Curiously enough I have always heard of it on the south-westerly shore of the River or the Islands, never in a wild state on the northerly or easterly bank, nor can I discover it on the Kennibecasis tributary, where I have searched for it, as I have a summer residence at Lakeside near Hampton, where I am collecting these wild vines from Westfield, Greenwich, etc., with a view to amusing myself testing them as stocks on which to bud or graft some of the hardier improved varieties.

I am, Dear Sir, yours faithfully,

W. M. JARVIS.

FREDERICTON, N. B., DEC. 29, 1883.

My Dear Doctor Lawson,—I am in receipt of your note referring to the distribution of the wild grape in New Brunswick, but regret to say that I have little information to give upon the subject. I have gathered the fruit in some of the valleys near

Fredericton, as at the Falls of the Nashwakasis, and it is quite common on the intervales and islands of the St. John River above this place, but I have never made any special notes regarding its occurrence. I think it likely that Mr. Matthew may be able to tell you something more about it, especially in the southern counties.

I am, Sir, &c.,

I. W. Bailey.

To the Editor of the Morning Chronicle:

Sir,—In regard to Professor Lawson's enquiry about localities where the wild grape vine is found on the Atlantic coast of this part of America, I would beg to state that I have studied the botany of Prince Edward Island carefully for years and have never seen anything of this plant here.

There is apt to be a great incorrectness in the reports of unskilled observers on plants. Some species of our wild brambles which have a climbing habit, as *Rubus occidentalis*, might be mistaken for *Vitis*.

Yours,

Francis Bain.

North River, P. E. I.

The information so far obtained shows that the present most northerly points of the Wild Grape (Vitis cordifolia, or its near ally V. riparia) are the following :—

Annapolis Royal, Co. Annapolis.

West River, Co. Pictou.

St. John River, New Brunswick.

Isle aux Coûdres, St. Lawrence River.

ART. V.—SABLE ISLAND, (CONTINUED.) BY S. D. MACDONALD, F. G. S.

Read Feb. 10, 1884.

IN my former Paper on Sable Island I introduced to your notice its general features, intending at some future time taking up and working out in detail, some of its most remarkable points of interest. To-night I would call your attention to some of the many changes it has undergone, which have materially altered its position.

On the early charts of this coast compiled and corrected from those of the French, and published in 1775, this island is shown as occupying a position between 60° 05′ and 60° 45′ W. long., 40 miles in length and $2\frac{1}{4}$ miles in breadth.

In 1799 a special survey of this island was ordered by the admiralty, and the chart we have before us this evening was issued together with numerous views of its appearance from different points of approach, also a scene of what is evidently an encampment of shipwrecked persons among the east end, naked sand hills. Many of the party are dressed in antique costumes, cocked hats, &c.

Those naked sand hills have always been an object of peculiar interest here, owing to their assuming such fantastic shapes, and by their colour, being more readily seen in the distance. Viewed in this engraving they appear to have attained quite an elevation.

On a plan published by Mr. Darby, one of the superintendents, is a cone shaped drift at the western extremity, marked the "volcano," said to be upwards of 100 feet in height, similar to one of those represented in this engraving. But the volcano has been dispersed. The position it occupied passed seaward many years ago, and now lies fathoms deep.

This survey appears to have been a very elaborate one and well prepared, upwards of 500 soundings are represented in the immediate vicinity of the island, and on the bank. This has resulted in locating the island as follows:

West end 60° 32′, east end 60° 01′. Length 31 miles, breadth 2 miles. Showing a decided decrease in area since previous observation, and placing the west end 22 miles further east.

The next survey was that of 1808 of the Island proper, ordered by General Sir George Prevost, then Governor of this Province, who moved by the terrible circumstances attending the loss of the troop ship "Princess Amelia," made every effort to induce the British Government to erect or aid in the erection of a light house on the Island.

Lieut. Burton of the Fusiliers, then stationed at Halifax, was dispatched to report on the feasibility of erecting a light, and to inquire into the wants of the Island.

From this report we learn the Island was 30 miles in length and 2 miles in breadth, with hills from 150 to 200 feet, beginning at west end and attaining their greatest elevation at Mount Knight, its eastern extremity.

Just a few words here with regard to the correctness of this first chart. It may be thought by some that little dependence should be placed on a chart compiled at a time when so little was known of the coast. But we have only to remember that this Island was well known to the French as early as 1598, and that forty years previous to this chart being compiled the walled City of Louisburg was at the zenith of its prosperity, with its magnificent fortresses which were 30 years in building at a cost of five millions five hundred thousand dollars, the station of a powerful French fleet which for armament and numbers has never been seen in North American waters since, and a city whose commerce was of no little importance.

Then, as now, in early springtime the Gulf of St. Lawrence current brought down its fields of ice blockading the south shores of Cape Breton. To avoid which those cruisers and merchantmen bound for the harbour of Louisburg were compelled to run south and westward, making an off shore approach which would throw them in the immediate vicinity of the Island. Also on two occasions a British besieging squadron lay before that city and cruised off its shores, the strength of which can be estimated when we learn that on one of those occasions 140 sail, of which 36 were frigates and ships of the line, left Halifax for Louisburg in a single day.

All this seems to warrant the conclusion that the knowledge possessed in early times of the coast and the adjacent islands was even greater than ours of to-day. And it is difficult indeed to give a satisfactory explanation of the variation of those charts unless we attribute it to actual changes undergone. But let us proceed.

In 1850 the late Hon. Joseph Howe visited this place as commissioner, for the purpose of making himself personally acquainted with the Island and its requirements. In his report he called the attention of Parliament to the rather startling fact, that by actual measurement the island had decreased at the west end 11 miles in the last 30 years. And further, for the safety of navigation and the prevention of disasters their first duty with regard to Sable Island was to have the position defined.

In the cabin of the "Daring" before him lay a chart by which that vessel was supposed to be navigated, also another compiled from observations taken by Capt. Darby in 1829. The discrepancy between which, and its possible effect on navigation, was appaling to contemplate.

The variations were as follows:—

The cutter's chart, W. E. 60° 32′ W. lon.
" " E. E. 60° 03′ "
Darby's chart, W. E. 60° 10′ W. lon.
" E. E. 59° 48′ "
Difference 22 miles.

This chart on board the cutter appears to have been one issued about 1815, on which the island is made to be 29 miles in length, a difference of 2 miles smaller than the chart of 1799.

On the strength of Mr. Howe's report, the admiral was communicated with, who ordered Commander Bayfield and staff to the island for the purpose of making a new survey. A corrected chart was issued by Bayfield the following year, locating the Island as follows: W. E. 60.08., E. E. 59.45., showing a still further reduction of area, and placing the west end 2 miles still further eastward than shown by Darby's chart of 1829.

Surprising as this evidence of change may appear it is fully borne out by the testimony of all those whom fortune has led in the interests of humanity to dwell upon its shores.

The position chosen for the main station in 1802 was one remarkably sheltered among the sand hummocks at a distance of 5 miles from the west end.

In 1814 the superintendent, Mr. Hudson, wrote the Government, that owing to the rapid manner in which the island was being washed away it would be necessary for him to remove the establishment to a more secure position; that within 4 years previous, 4 miles had gone entirely from the west end, leaving but a mile between him and the sea, which was advancing steadily. On the north side an area equal to 40 ft. wide and 3 miles long had gone bodily from the island during a single night. He intended moving the buildings to a place called "Middle Houses," 3 miles further east.

In 1820 the superintendent again wrote the Government, "that not only had the old site of the main station gone seaward; but the sea was again encroaching to such an alarming extent that he would be obliged to once more remove the station, and had selected a place known as the "Haul over," 4 miles further east. This moving of the main station incurred no little trouble consisting as it did of superintendent's dwelling, another for the staff, a sailor's home for the accommodation of shipwrecked persons, stores for provisions and material saved from wrecks, barns, workshops, boat house, &c.

Again the sea advanced, the two following winters were noted for the frequency of storms and the havoc made along the sand cliffs, every gale sensibly diminishing the western portion of the island, toppling great masses of sand hills into the surf below as well as changing the surface of the interior. One instance I have already mentioned in my last paper when thousands of tons of sand were carried from the beach and strewn over the island, smothering vegetation, so that hundreds of horses died for want of food.

Seeing the necessity of securing more permanency for the main station, and the buildings from being so often removed, becoming dilapidated, the present position was selected on the broadest and most protected portion of the Island and new buildings erected in 1833. The old dwelling of the superintendent was again removed 4 miles further east and used as a house of refuge. Here it enjoyed a short respite when again the sea threatened its foundation. This marks the 11 mile point mentioned in Mr. Howe's report.

Now all this seems so much like romance that were it not for the authenticity given it by parliamentary reports and the records of the Island, I should hesitate in giving currency to these statements.

But I think I hear you say,—What of that house—is it still moving?

No, it is now at rest, it has found a grave, for the fourth time it was moved, this time 2 miles further east. Gradually the gales removed the hummocks that sheltered it. Then, left to the rake of the winds, sand laden eddies twirled about it till slowly mound arose closing it from sight, the house, and the surface became levelled out above it.

Another short rest and again it may open up to view, and be bared to its foundation, or be thrown down with the embankment and floated away by the current.

Between the years 1850 and 1881 this western portion of the island appeared to enjoy a period of comparative repose. This may be accounted for by the fact that so much material had been thrown down a shoal was formed to the west on which the seas would probably break before reaching the sand bluffs and thus lose their abrading force. In the same manner the main body of the island is defended by three parallel bars which act as barrier reef, and protect or at least retard the work of devastation which would otherwise proceed with great activity. On the removal of this shoal to the westward, by the currents, the seas began again to manifest their force.

The winter of 1881 was remarkably stormy, gale succeeding gale in quick succession. In addition to this gradual work of erosion great areas were removed bodily. During one gale 70 feet by ¼ mile departed, a month later 30 feet of the whole width of the island disappeared in a few hours.

The winter of 1882 was even worse than the preceding one, and was noted for the destruction wrought among the buildings, including the west end light house, a magnificent structure erected in 1873, one mile inside the grass hills.

Early in Feb'y. of that year a gale of unusual violence visited the Island accompanied by very high tides; already the sea had removed the embankment to within 40 feet of the bluff on which the light house keeper's barn stood, and within dangerous proximity to the light house itself. As the tide rose the gale increased. All hands were now out ready for any emergency that might require their presence.

The cattle had been removed to the porch of the light house. As the staff were watching the force of the waves that were now undermining the embankment with great rapidity, suddenly a depression along the margin of the cliff gave warning of a downfall. The next instant an area equal to 48 feet broad and a ¼ of a mile long descended into the surges on the north side, while during the night the 40 feet in front of the barn and along the sand bluff dissappeared; next morning the barn went crashing below and was swiftly carried away by the current.

The storms that produce the most destruction are those from the S. E. bringing in heavy seas, which striking obliquely on the south shore aided by the powerful current setting to the west erode the sand cliffs until large masses are detached, fall into the current, and are carried forward. This also helps to prolong the N. W. Bar.

Again, during calm weather when winds and waves are still, the shores and bars are white with foam from the ever present ground swell which renders landing so precarious; it is seldom attempted except by the surf boats at the station.

In the loss of the west end light-house we have a remarkable instance of the wasting force of this swell. The weather had been unusually quiet for the space of two days, during which time a heavy ground swell hove in from the S. E., (probably from a gale passing along the gulf stream), which carried away the remaining 12 feet of embankment in front of the light house, causing it to lean dangerously forward, and necessitated the hasty removal of the apparatus. From this time the light ceased to send its warning across the waves.

While changes are readily observed along the bluffs the beach itself is continually varying in form, increasing and diminishing in particular parts. In this way old wrecks are brought to the surface and others concealed during a single gale.

Some years ago, after a heavy gale, spars, canvas huts, &c., showing a prolonged stay of which there is no record, were discovered. This spot has also passed under the sea.

In 1837 Mr. Miller, the third commissioner appointed to enquire into the possibility of erecting a light house, reported that on visiting the Island he found the position chosen by him in 1833 had undergone a complete change. The site selected by a former commissioner favorable to the project, had been completely removed by the high winds that have at times so much effect in causing remarkable changes in the interior, as well as on the shores of the Island. He would only feel justified in recommending a temporary erection, such as could be easily removed to a more permanent position when necessity required it.

We can readily understand how hills of loose sand thrown up by the wind into every fantastic shape that snow drifts can assume, are ever changing their extent and position.

The removal of those sand drifts or dunes have brought some interesting historical facts to light.

In 1842 during a severe gale an old landmark in the form of a pyramid near the west end station, said to be 100 feet in height, was completely blown away, exposing to view several small houses built from the timbers and plank of a vessel; on examination they were found to contain quite a number of articles of furniture, stores put in boxes, bales of blankets, quantities of military shoes, and among other articles a dog collar of brass, on which was engraved the name of Major Elliot, 43rd Regt.

It was afterwards ascertained that this regiment while returning to Halifax after the siege of Quebec, was wrecked here, but afterwards taken off without loss of life.

Many years ago a roundsman's attention was attracted to a blackened line along the sand cliff; on climbing to the place and removing the sand he uncovered what afterwards proved to be the site of an old encampment. Here lay rusty guns and bayonets, knives made from iron hoops, broken glass, a tattered English ensign, human bones, mingled with those of cattle and seals, an English shilling of the reign of Queen Elizabeth, sharp as when taken from the mint which furnishes the date of the disaster. But nothing further left to give a clue to the sufferers, except that they were Englishmen.

Thus those gales are ever bringing to view, evidence of calamity of which history and tradition are equally silent.

Turning to the lake we find more proof of the vicissitudes this Island has undergone. When first known the lake had an opening on the north side which was afterwards closed. A few years later during a terrific storm the seas forced a channel through the lake margin on the south side rendering it a convenient harbour for small vessels. But in 1836 a similar tempest closed it again, shutting in two American fishermen, who ran in for shelter on seeing the storm approaching.

Gradually it became very shoal from the material drifting into it, but being dammed up by the closing of the inlet and filled by the surf washing across the ridge, it afforded great facility for forwarding the life boat in case of a wreck, and the transport of wrecked material to main station for shipment.

During the winter of 1881, a severe gale opened a gulch towards the east end, so draining it as to reduce it to 8 miles in length and rendering it useless as a means of transport.

The lake margin forming the south shore in like manner testifies to the destructive agency of the sea. Having a breadth at one time of ½ a mile, with sand hills of upwards of 50 feet in height; at present it is merely a narrow ridge forming a precarious sea wall, over which the waves now break in heavy weather. Should this inner barrier be removed the work of demolition will go forward with increased rapidity.

During storms, in addition to the actions of waves and currents, the winds independently ravage its surface.

Finding a raw spot, as it is termed, the eddying winds scoop out the loose sand (when not confined by the roots of the grass) into bowl-like depressions, which afterwards form those fresh water ponds so often found in the interior, while around the stations it requires the utmost vigilance of the men to watch the first break in the sod and repair it before headway is gained, otherwise the buildings would soon go from their foundations.

While the wind and waves have been so active modelling and remodelling the Island proper, currents and eddies have also been at work on its submerged portion, although from the difficulties attending observations we are not cognizant of the various changes taking place. One however, fraught with much danger, is making itself manifest in a painful degree, that is, the prolonging and shoaling of the north east bar.

By reference to this wreck chart, it will be seen that most of the wrecks of late years have occurred here, some of them being as much as 16 miles from the light.

The changing character of the bar at the other extremity of the Island may be inferred from an extract of Capt. Darby's reports in Blunt's Coast Pilot of 1832, as follows:—

"I have known this Island for 28 years, during which time the west end has decreased in length 7 miles, although the outer breakers of the N. W. bar have the same bearings from the west end of the Island as they formerly had, demonstrating that the whole bank and bar are travelling eastward."

With regard to this Island having travelled the entire distance shown by those charts, it would be rather hazardous to adopt such a conclusion. Yet it is certain that its progress eastward is in keeping with the natural tendency of all sand accumulations, and although the material may be carried sometimes one way and sometimes another, yet nevertheless its progress must still be in the direction of the prevailing wind.

In some parts of the world in consequence of the preponderance of certain strong winds in one direction, such accumulations make a regular progressive movement, and have buried farms, houses, cities, and even whole tracts of country, of which there are numerous instances on the English and French coasts.

At this island the strong west wind is as constant as a trade wind, and its material is being constantly blown before it.

In this way the amount drafted from west to east must have been enormous and may account to a great extent for the diminished height of the Island. At the same time I think we are justified in concluding, that while the Island has traversed a certain portion of this distance, its changed position as here indicated by those admiralty surveys, is mostly due to submergence.

Of course an Island so constituted, exposed to the unobstructed violence of the whole Atlantic, could not long resist the terrible abrading force of the breakers, aided by swift currents, and the denuding effects of wind and rain.

Already we have seen that within a comparatively short space of time, dating back but a few years previous to the founding of the life saving station, it has decreased in length from 40 miles to 22; in breadth from 2½ miles to something less than 1 mile; in height from 200 feet given in 1808 to 80 feet, according to the latest observations.

The future of this Island to the navigator is everything but cheering. Should those destructive forces now in operation continue, we might easily calculate on a period, and not a remote one, when the sea will claim it as its own.

ART. VI.—GLACIAL ACTION, AT RIMOUSKI, CANADA, AND LOCH ECK, ARGYLESHIRE, SCOTLAND. BY REV. D. HONEYMAN, D. C. L., F. S. A., &c., *Curator of Provincial Museum.*

(Read. 10th March 1884.)

ON the 3rd of last November I made an observation near the I. C. R. Station at Rimouski, which I regard as interesting. On both sides of the Road I found and examined boulders, many of which were of large size; one had been blasted to make way for a fence. Others were evidently undisturbed, being, doubtless, in the positions in which they had been deposited during the glacial epoch. They are of crystalline rocks, of the Archæan (Laurentian,) formation. There are no exposures of rocks in the vicinity.

From what I have seen of the rocks in the district I have no hesitation in regarding the boulders as travellers from a distance. The Laurentian Formation lies on the north side of the river (St. Lawrence,) at a distance of 20 miles from the position of the boulders. They have travelled a distance, of at least 27 miles. Specimens of the boulders before you are, first, a beautifully banded gneiss having black mica (muscovite) and white quartz; second, also beautifully banded having black mica and reddish quartz; third, is of black mica and yellowish quartz; it is also banded but not so beautifully as the other two. On two other occasions I was in this locality, but without time to make any observations. The transportation observed was not unexpected. In Sir W. E. Logan's table on glaciation, I found that at Kempt Road near Metapedia Lake, Lat. 48° 32', Long. 67° 43', there is glaciation having a course of S. 80° E. On the admiralty chart I had also observed that the glaciation of Point Pleasant extended N. E. passes through Rimouski at a distance of 310 miles. The longitude of Rimouski is 68° 32', and the latitude is 48° 28'.

The striation at Metapedia Lake, if extended in the direction of Rimouski would pass considerably to the north of the boulders, as the latitude of the one is 6' north of the latitude of the other, and the longitude 49' less. In my last paper on Glacial Transportation I observed that the extreme points of my observations were George's Bay, Antigonish, N. S., Long. 62°, and Kingston, Ontario, Long. 76° 29'. Two other extreme points are Halifax, N. S., latitude, 44° 44', lat. 48° 22', and Rimouski, Quebec.

LOCH ECK, ARGYLESHIRE, SCOTLAND.

In the month of July I had an opportunity of making some geological observations in the West of Scotland, especially in a corner of Argyleshire, at the Firth of the Clyde and Loch Long. My headquarters there were Blairmore. On the shore are interesting exposures of strata which are evidently near the Geological horizon of our own Cambro-Silurian formation. These are b^{1},' b^{3}'. b'^{4}', Silurian, Clay, Chlorite, Mica, Slate, and Gneissose rocks, based on quartzose, flagstones, quartz rock, &c. Vide Murchison & Geikie's First Sketch of a New Geological Map of Scotland, 1861. From Blairmore I proceeded to Kilmun, thus passing farther along b^3. Then taking a course N. E., towards Loch Eck, I passed through b^c and into b^4, going beyond Ben More, at the beginning of Loch Eck my attention was attracted to a rock on the right side of the road. This was furrowed by familiar glaciation, unfortunately I did not have my compass to take the course of the striation. It was apparently towards the S. E. The rock itself is a micaceous schist. We followed the course of the River Echaig, as far as its falls. The water was low at the time and gave an excellent opportunity of examining the magnificent exposure of schist. It is wonderfully worn and excavated by the action of the water, which passes through a narrow gorge. The rock is replete with pot holes,some have had sides worn and the boulders have escaped. Looking at the lofty hill ridges on either side of the valley, and beyond the falls, one is impressed with the adaptation of the position for an Alpine glacier. Of course other geologists have noticed this, although I have failed, on enquiry, of learning the fact.

ART. VII—NOTES OF A POLARISCOPIC AND MICROSCOPIC EXAMINATION OF CRYSTALLINE ROCKS OF NOVA SCOTIA AND CAPE BRETON. BY REV. D. HONEYMAN, D. C. L., F. R. S. C.

(Read 11th Feb. 1884.)

INTRODUCTION.

1. Basalt........................of Blomidon, N. S.
2. (boulder.)..................Weymouth.
3. Basalt.................Jebogue Point, Yarmouth.
4. Diorite............St. Peter's Canal, Cape Breton.
5. Diorite.........................Cranberry Head.
6. Diorite............................ Nictaux.
7. Diorite....................Cobequid Mountains.
8. Porphyrite.............Sunday Point, Yarmouth.
9. Porphyritic & Amygdaloidal..Cobequid Mountains.
10. Porphyrite..................Cobequid Mountains.
11. Hornblendic rock..............Yarmouth Harbour.

I have had sections of the preceding rocks carefully prepared by Dr. Alexis S. Julien, New York. Four of them have already been imperfectly examined by an inferior polariscope. I have re-examined these thoroughly by the splendid new Polariscope-Microscope made by Anderson & Sons, London, for our President, and added the other seven to the number; and I propose in these notes to give an account of the interesting results and to illustrate with the instrument.

DOLERITES.

1st. I begin with the Blomidon Basalt, as this mountain is well known wherever Nova Scotian mineralogy is an object of study. Its zeolites and other minerals are to be found in all great museums, and it is noted in works on general mineralogy as one of the principal localities where trappean minerals can be collected. The section examined is of a compact basaltic prism which I picked up at the foot of the mountain in 1875, *(a.)* Examined by the Polariscope, with *nicols* crossed, the section is brilliant and striking. Revolving the Polariser or Analyser, as both can be turned, the change in prismatic colours, and their arrangement is kaleidoscopic. The abounding parallel lines with changing and alternating colours (trichoic) indicate combinations of crystals into twins, three lings and four lings, with chroism of labradorite, among these is a constant, unchanging brown colour, this distinguishes augite from hornblende, which is dichroic. We have thus indicated the two minerals which constitute a *dolerite.* When the *nicols* are crossed parts of the section have a vivid chromatic polarisation. This is owing to the presence of quartz. There is also another obvious constitutent which is opaque. All that we can distinguish with the polariscope is the presence of dark forms with acute angles or of irregular shape. (*b.*) Removing the polariser and analyser we then examine them in sunshine with the microscope, the dark forms are seen to be blue-black in colour with metallic lustre. This shows that it is the mineral *magnetite.* Surveying, then, the whole section we find a large number of these. At the same time we detect green specks of olivine. The basalt is therefore dolerite, consisting of labradorite and augite with the accidental minerals, quartz, magnetite and olivine. 2nd. A boulder of Basalt. When I was surveying parts of the Counties of Digby and Yarmouth, Trans. Inst. 187, I observed at the Weymouth Station of the Railway a large, rough-looking boulder; breaking part of it I found it to be basaltic. It was considerably weathered and easily broken. Examining the pieces macroscopically I found it replete with crystals of olivine of considerable size. These, like the rock, had suffered from decomposition and were very friable. Regarding it as different from the basalt of Blomidon in having olivine, I called it an "Olivine Basalt." The examination of the preceding basalt shews that this is a useless distinction. As fas as I can find this is the first time that olivine has been found in these basalts. (*a.*) Examined with crossed *nicols* the section of this boulder surpasses the other in brilliancy. The crystals are similarly pervaded by parallel lines. Turning the polariser, these are also trichroic. Before the polariser is turned, the vivid chromatic polarisation of the quartz is greater than that of the preceding section. The unchanging greenish brown colour shows the presence of augite, dark forms are also seen but they are small. A crystal of olivine of bright green colour adds to the variety. (*b.*) Examined by the microscope in sunshine, the small dark forms are seen to be of magnetite and to be arranged in groups rather prettily. The crystal of olivine is seen to be surrounded with a decayed crust which has lost its green color. Smaller crystals, (broken,) are seen in different parts of the section. The constituents of the boulder are thus, labradorite, augite, quartz, olivine, magnetite.

2nd. Basaltic dyke at Jebogue Point. I have partially described this already, as peculiar and interesting because penetrating Cambro Silurian rocks. I would now describe the section more particularly. (*a.*) In the polariscope with crossed nicols, it appears dark, with faintish light, excepting when it is surveyed throughout, the crystals of good size are seen divided by a median line. Turning the polariser these crystals are brilliantly trichoic. They are therefore labradorite twins. Numerous small crystals are also seen, which are also trichroic and give considerable brightness to the section when the nicols are parallel. The dark brown colour is constant, indicating a predominance of augite, Occasional bright spots with quartz polarisation occur. Other sections might shew more of this, as a macroscopic examination of the rock shews amygdules of quartz, and grains in abundance. (*b*) Examined with the microscope, numerous black grains combine with the augite to darken the section. These are seen to be magnetite. Brassy crystals are also of frequent occurrence. These are of pyrite. Olivine is not observed in this section. The minerals in this basalt are thus labradorite, augite, quartz, magnetite, pyrite. This rock has the same essential minerals as the two preceding, and is a dolerite. They differ in proportion. It has the same accidental minerals only *pyrite* takes the place of olivine. Is the third identical with the first and second? Or is it part of an older rock than these?

DIORITES.

4. I take as a typical diorite a crystalline rock which occurs in Cape Breton, in that narrow neck of land which separated the waters of the Atlantic and the inland waters of Cape Breton but which have recently been connected by St. Peter's Canal. The specimen which furnished my section is one of a collection made at different depths in the process of excavating the canal, and kindly presented to the Museum by a gentleman residing in the locality. I visited the locality in 1861, after the excavation had been begun and work suspended. I then noticed the rock but did not examine it particularly. The Geological formation of the locality is Carboniferous. I collected *flora* in the vicinity, the precise relation of the rock to the formation may be uncertain, it is likely a pre-carboniferous diorite. (*a.*) Examined with crossed *nicols*, it is more beautiful than any of the sections already described. Seven prismatic colours, violet, blue, orange, yellow, &c., are arranged in four groups and in parallel lines. This is pleochroism in the strictest sense. In an orange colored crystal there are 7 parallel lines. Turning the polariser this becomes trichroic, but without alternation between the parallels. A very beautiful group of colors show the arrangement from left to right, deep blue, violet, yellow, orange. yellow, violet, light blue in parallel lines. Turning the polarizer from left to right about half a revolution the arrangement

changes to yellow, dark blue, light blue, yellow, orange. We have thus a triclinal feldspar, oligoclase. Crossing the nicols, we observe on the right side of the last described, a lovely green, giving the polariser half a turn the green is changed to a bright purple. This is a dichroism indicating hornblende. Surveying the field while turning the polarizer the pleochroism and dichroism is constantly appearing. The rock is thus evidently a diorite, there are also black forms constantly appearing. *(b.)* Examining there with the Microscope they are seen to consist of magnetite and pyrite. The minerals of the rock are oligoclase, hornblende, magnetite, pyrite.

5. This is the section of a rock which I observed at Cranberry Head, Yarmouth County. It is associated with Lower Cambrian rocks, and in close proximity to the auriferous strata of the gold mine. On this account it is singular and interesting. *(Vide paper, Transactions.)* I described it as a diorite. Looking at the section with crossed nicols, we see a pleochrism of pretty much the same character as that of the preceding, but not so brilliant. Turning the polariser, the changes also bear a close resemblance. Parallel lines are equally numerous. There is also a corresponding dichroism throughout the section. We have thus as constituents of the rock oligoclase and hornblende. There is also mica, an accidental mineral, whose presence is readily enough observed macroscopically. Opaque forms are abundant. *(b.)* The microscope shows that the opaque forms are of magnetite and pyrite. The minerals of this rock are oligoclase, hornblende, mica, magnetite and pyrite.

6. Diorite of Nictaux. The rock of our section belongs to a very important series of intrusive rocks which I have pointed out and described in my papers (1) "On the Geology of Kings Counties;" (2) "On the Geology of Annapolis County;" (3) "On the Geology of Digby and Yarmouth Counties." *(Vide Transactions.)*

On geological considerations, and from macroscopical examinations, I have named these diorites. Members of the series have been pointed out as occupying the dividing line between the lower and middle Silurian and the lower Cambrian (auriferous) formation at Nictaux, Bear's River and Cape Cove, Cape St. Mary's, Bay of Fundy. These diorites have themselves been referred to post-upper Silurian and pre-carboniferous (Devonian) time, with similar rocks of *undoubted* Devonian age, at Arisaig, Antigonish County, and East River, Pictou County. *(Vide papers in Transactions.)* Of these I intend to have sections prepared for subsequent examination.

(a.) One section examined by the polariscope, with crossed nicols and revolving polariser, shew, first, a brilliant dichroism indicating the existence of a large proportion of hornblende. The other chief constituent mineral is a triclinic feldspar albite. That the feldspar is triclinic is evident from the forms of the crystals, medium lines, twining, and other parallels. When the nicols are crossed these are distinctly seen. There are no prismatic colours between the parallels. The colors in this case are purplish, grey and white. Turning the polariser these are seen to change from light to dark, or *vice versa*. (In the Blomidon basalt section there occur, often, crystals having the same character.) There are also opaque forms in considerable number. *(b.)* Examined by the microscope these appear as magnetites and pyrites.

The minerals of this rock are albite, hornblende, magnetite and pyrite.

7. Diorite of the Intercolonial Railway, Cobequid mountains. In the Wentworth cutting I have pointed out the singular association of Lower Silurian claystones, having characteristic fossils with crystalline rocks which have every appearance of being interbedded igneous rocks. I characterized them as *homogeneous* diorites—*(Vide* papers "Geology of the I. C. R.,"—*Trans.* 1873.) —they appeared so *macroscopically.* I have selected one of these as a representative of this series and had a section made. This is far from being *microscopically* homogenous; so that the term "homogeneous" is no longer appplicable to these rocks. *(a.)* Examined by the polariscope it shows much dichroism from the prevalence of hornblende. The predominence of light crystals with median and other parallel lines, indicate the prevalence of triclinic feldspar. The colours within the parallels resemble those

of the preceding (Nictaux) section, and indicate albite. The rock is therefore a diorite. Opaque forms are numerous. *(b.)* These examined by the microscope are seen to be pyrite and magnetite. The pyrite is readily seen in the rock with a pocket magnifier. The minerals are hornblende, albite, pyrite and magnetite.

PORPHYRITES.

8. Sunday Point Porphyrite. Macroscopically this rock consists of a darkish groundmass, with light colored crystals plentifully distributed ; hence I have named it porphyrite. Mica is also observed as a prominent mineral. *(a.)* The section examined by the polariscope, with crossed nicols, and the turning of the polarizer, show the crystals with parallels and pleochroism only inferior to that of St. Peter's Canal typical diorite section, and surpassing that of Cranberry Head. The groundmass itself is evidently largely composed of oligoclase. Dichroism shows that another constituent is hornblende. The rock is therefore a diorite-porphyry. The opacity of the groundmass arises, to a large extent, from the abundance of black granules, clouded spots and dark grains. *(b.)* These examined by the microscope are seen to consist of magnetite and pyrite. Mica is also present. The constituent minerals of the porphyrite are thus: oligoclase, hornblende, mica, magnetite and pyrite. Sunday Point is situate at the mouth of Yarmouth Harbour, between the latter and Jebogue Point. It is nearer to the latter than to Cranberry Head. Our polariscopic and microscopic analyses show, however, that the crystalline rock of Sunday Point is more closely related to that of Cranberry Head than it is to that of Jebogue Point, and that they may belong to two different eruptions, ages apart.

9. Porphyrite and amygdaloid diorite of Cobequid mountains, near Wentworth station, I. C. R. In my paper on the I. C. R., I described a very coarse conglomerate, consisting largely of volcanic constituents. This seems to have been the product of a sub-marine volcano of Lower Silurian or Upper Cambrian age. Part of this conglomerate was a singular and rather beautiful rock, having a green groundmass, with amygdules of white calcite and crystals of reddish feldspar.(?) This is the rock of our sec-

tion. The groundmass transmits polarised light with the nicols crossed, and brightens considerably with the turning of the polariser. Its dichroism shows that one constituent is hornblende. Crystals interspersed, having median lines and the general colours, seem to indicate albite as also a constituent. The red crystals which led me to characterize it as porphyrite, are of uncertain character, not having any distinguishing feature. The amygdules which I consider to be calcite, show a varied and beautiful *chroism.* One or two of these are pervaded by fine parallel lines which are sometimes crossed by other parallels. The turning of the polariser does not much affect this striation. It is not, therefore, of the character of the feldspar striation. Some of the amygdules are of a yellow colour; three of these are in the section with the nicols crossed; these are green and black, so arranged as to appear to radiate from the centre. Turning the polariser half a revolution, they become yellow, without the appearance of radiation. The mineral is evidently *dichroic.* I do not know what it is. There are also dark forms in the groundmass. *(b.)* The microscope shows that these are magnetite. The constituents of this rock are therefore hornblende, albite, calcite, magnetite and (?) mineral.

10. In the second of the Whetstone Brook sections which succeed the Wentworth, I. C. R. is porphyrite which is associated with Diorites. The slates which include them have only produced one fossil a large *lingala.* They have been referred doubtfully to the middle silurian period. *(Vide,)* paper already referred to. This porphyrite has a dark ground mass in which are scattered reddish crystals and kernels of hyaline quartz. *(a.)* In section the ground mass transmits light with crossnicols and brightens with rotation of the polariser, hornblende is evidently one constituent.

The sections of the reddish crystals are dichroic, the mineral is therefore monclinic, orthoclase. One has four different shades of color (brown,) irregular dividing lines which deepen in different degrees with the rotation of the polariscope, and after half a rotation or a little more, becomes white (grey.) One of these has a distinct inclusion (mineral.) The hyaline quartz is of a dark blue when the nicols are crossed. The ground mass is unindividualized. *(a.)*

The microscope shows magnetite in grains. The rock is thus composed of hornblende albite (?) quartz and magnetite.

11. At the head of Yarmouth Harbor is a peculiar hornblendic rock. In the paper on the Geology of Digby and Yarmouth, this rock has been pointed out. In my other paper on Polariscopic examination, I have referred to some of the peculiarities of a section of it. I referred to part of its hornblende with a singular, glassy inclusion. I have now ascertained the character of the other chief constitutent of this rock. Comparing it with the section of a typical quartzite, I find it has a similiar dichroism, blue and yellow, only the granulation of the rock is much finer. It requires a higher power to distinguish it, when the polarizer is not used. Glassy portions which do not transmit light, with the crossed nicols occur in the quartz constituent of the rock as well as in the hornblende. *(b.)* The microscope shews these to be magnetite. The constitutents of this rock are therefore, quartz, hornblende, magnetite, glass with or without inclusions. The rock is metamorphic and of Lower Cambrian age.

Inferences.

There are several interesting points that are brought into prominence by these examinations.

1st. The value of the Polariscope and Microscope to the practical geologist. This is evident from the correspondence between observation in the Field and the Polariscope-microscope and from the comparison of observations in my published papers with the observations just submitted. The names given to rocks examined in the Field are in accordance with the names which the Polariscope and Microscope designate, and conclusions arrived at there have been confirmed by the process of examination.

2. In every rock examined magnetite is found. It is thus seen to be distributed far more extensively than we could have ascertained without the aid of the microscope.

4. It reveals to us the origin of some of our magnetic sands, *e.g.*, magnetite was found among the gold and garnet sand at Jegoggin Point. The source of the garnets was obvious and the probable source of the gold was indicated. That of the magnetite only was uncertain. Hornblendic rocks, like these of Yarmouth

Harbour, occur at Jegoggin Point. From these we may have the supply of magnetite.

The magnetite represented by the sections described has also been rendered obvious by reducing pieces of the rocks to a powder in a wedgewood mortar and extracting the magnetite with a magnet.

Art. VIII.—Some Physical Features of Nova Scotia, with Notes on Glacial Action. By M. Murphy, C.E., *Provincial Government Engineer.*

(Read April 14, 1884.)

From the year 1869 to 1872 it was my duty to survey some of the Gold Districts which lie in various directions along the Atlantic slope of the Province; and subsequently it became a no less pleasing one to conduct some railway surveys, the course of which was right across the general direction of the strike of the gold-bearing rocks. During these labours and journeyings my work was entirely confined to surveys and public works. Such observations as I was able to make of a general scientific character, were necessarily incidental, hasty and external; however, these defects of hurried and superficial observation will be found in the details only. I am able to place before you a correct representation of the geological skeleton, the characteristic outlines, and true topographical section on two lines of profile across the province, between the Bay of Fundy and the Atlantic shore. The line of railway in operation from Halifax to Windsor gives a third such profile. All are between the 44th and 46th meridians, and are nearly parallel to one another. These sections or profiles may be said to possess advantages in facilitating the formation of more comprehensive views on the large scale, and may also tend to enable other and more definite contributors or observers, by adding one range of vision to another, to take in at a glance a much more concise perception of the extent and general outline of their more prominent features.

The sea board of the south-east coast, between Cape Canso to the north-east and Cape Sable to the south-west, is no less than 230 miles in a straight line, the general trend being about east-by-north and west-by-south. Throughout the whole extent of this rocky coast, say "The Sailing Directions," are numerous "indentations, varying in size and utility, from the narrow creek "in which boats seek shelter, to noble harbours, of which Halifax "is the largest, most accessible and safest."

A well defined low mountain ridge courses with nearly the same trend as the shore line, and forms the principal water-shed of the Peninsula; its slopes run northerly and southerly from it, the latter, or southern slope, being somewhat undulatory, but regular in its descent to the Atlantic.

The south-eastern slope, for nearly its entire length of over two hundred miles, has undergone very extensive denudation; the phenomenon of scratching and polishing prevails almost everywhere over its surface; the striæ are remarkably distinct in many places. Point Pleasant and Leahyville, near Halifax, are examples. When the drift or boulder clay is removed, the scratches and furrows are frequently met with, and they are generally in the same direction; yet, there are some places where the striæ, or markings, exhibit different courses. Near Morgan's, on the LaHave river, the course is S. 63 W., whilst in a valley about five miles east, the course is quite different, being nearly north and south.

The direction of the strike of the gold-bearing rocks is generally very regular, and nearly at right angles to that of the glacial groovings, the former being nearly east and west, whilst the latter is north and south. Subjoined I give the general direction of the strike of the slates in our principal gold mining districts, with as many notes of the courses of the striations as I am able to place before you:

	Course of Strike.		Course of Striæ.	Year when taken.
1. Goldenville, nearly	E. and W.		N. and S.	
2. 15-mile Stream	S. 80, E.		S. 10, W.	1868
3. Beaver Dam	S. 57, 30, E		S. 5, W.	1871
4. Tangier	E. and W.		S. 20, W.	
5. Carriboo Moose River	N. 87, E.			1876
6. do. Lindsay Lake	N. 75, E.			1881
7. do. Musquodoboit	N. 74, E.			1864
8. Gay's River (conglomerate)	N. 78, 25, E.		N. and S.	
9. Lake Catcha	N. 72, E.			1882
10. Chezzetcook	N. 75, E.			
11. Lawrencetown	S. 87, E.			1862
12. Waverly	N. 81, E.	(Exposure near W. Junction)	S. 5, E.	1865
13. Oldham	N. 82, E.		N. 10, E.	1862

The direction of the strike and the year when taken, were obtained through Mr. Carman of the Public Works and Mines Office. Some of the courses of the striæ were taken by myself, others by parties to whom I have applied in the present year. The bearing is magnetic.

The unmistakable traces which are so marked shew that vast glaciers must have once existed here, or, that these markings are due, as Dr. Dawson in his Acadian Geology seems to favour, to the abrasion of the rocks by icebergs coming from the direction of the sea. We have the carefully prepared and almost conclusive reasons given by Dr. Dawson on the glaciers and icebergs of the Post Pliocene period, published in 1868; but we have other authority on glacier action by equally active observers, such as Professor Tyndall and others. In examining the evidences which are illustrated by markings or striation running in the same general direction in Nova Scotia, and other phenomena which they suggest, it is not easy to assume any definite conclusion respecting this theory or that. Whilst quoting such authority let us approach this subject gradually.

Professor Tyndall, after discussing snow-crystals and regelation in his work "Heat as a mode of motion," discourses from actual observations of his own among the Alps, as well as from the records of other writers on the glacial action now going on in the Himalayas, the Andes and many other snow-laden mountains; and propounds the theory that the scars, flutings and furrowings visible along the valley of the Rhone for a distance of 80 miles. until lost in Lake Geneva, are due to the same cause. For, says the learned Doctor, " Grand as the present glaciers seem to those who explore them to their full extent, they are mere pigmies in comparison with their predecessors." By their predecessors he means, as expressed previously, traces of ancient glaciers.

There are many theories for the cause of glacier motion.

1. That of Dr. Saussure,—The slow but continual sliding of the icy masses on inclined bases.

2. The dilation theory, from expansion of water accumulating daily in its fissures, tending to urge the glacier onwards.

3. Then there is that of Professor Forbes, viz :—A glacier is an imperfect fluid or viscous body which is urged down slopes of a certain inclination by the mutual pressure of its parts.

The Encyclopedia Britannica, after giving in its usual precisive style, a description of the glacier, concludes its last paragraph on the subject thus :—" The problems of the cause of glacier motion cannot yet be considered to be satisfactorily solved," and goes on to quote the contributors on the subject, such as Professor James Thompson, Professor Forbes, Sir William Thomson, Tyndall, Faraday and others, ending with the views of Dr. Croll, who regards the motion of ice of a glacier as molecular, resulting from the very conduction of heat through the mass of the glacier, which will melt the ice and create a wave of thaw, but will in turn freeze again and cause a downward movement in the direction which has the least resistance, and the direction in which gravitation co-operates.

If we take a broad view of the extent of surface which exhibits such markings as those under consideration, we can scarcely admit the theory of a gradual subsidence and the re-elevation with the action of the sea and its currents bearing ice at certain seasons of the year, which is really that of Dr. Dawson.

The slope running back from the south-eastern shore to the top of the ridge of the low mountain range all the way from Cape Canso to Cape Sable, although rugged, undulatory and serrated, in numerous places, is nevertheless free from very high protuberances.

A large extent of its surface is so much denuded of drift that any extensive forest fire burns up all the clothing on patches of its surface, leaving the rocks so bare that the miner is invariably tempted to prosecute a search.

The presence of granite patches here and there at the existing surface, shewing that the denudation had reached so far, and the evidences of a granite nucleus in the higher ridge outcropping in like manner, shews that most of the strata under which the granite was consolidated have been reduced to a mere shell by denudation, a work which we could scarcely attribute to depletion by icebergs alone.

And again, the markings are mostly flutings or furrowings, and the mechanical action which caused them can be more reasonably attributed to a slow grinding process than to the force of impact by icebergs, which would exhibit more denticulated or notched abrasion.

The nature and extent of the work performed in excavating and removing a depth of rock surface probably greater in height than some of our present mountains, and extending over two hundred miles in length, could, to our senses, be more reasonably assigned to the agencies exerted in the glacial period or ice age, than any other we can conceive. If we assume a uniformity of action, and adopt the assumption that the whole slope of our Atlantic sea board was being sculptured or shorn at one and the same time by glaciers moving from the north, we can comprehend, to some extent, the cause of the glacial markings. The theory of Dr. Honeyman, of the drift from the north, is the only one that will truly reconcile us to the great effect produced. If denudation other than that of glaciers contributed to reduce the rock surfaces now visible above the sea level, they must have exerted their influence before the Post Pliocene period. The flutings, as I would call them, are, no doubt, the work of large superimposed masses moving slowly ; and these traces are on the floor, on the surface of our rocks only,—they have not been observed lower, so far as I can ascertain.

If we carefully observe the fluted-like etchings visible on the rock surfaces of Nova Scotia, with the view of determining for ourselves whether these markings were caused by a slow grinding process, or by the abrasion of icebergs striking, rocking or slipping on an inclined rock surface, we will, I have no doubt, conclude that the former, viz, the slow grinding process, was the much more likely to produce them.

If we judge from effect, there is no reason whatever that Dr. Honeyman's theory, which is, also, I believe, that of Sir William Logan and Professor Hind, that larger masses of ice moving in glacial form over the surface, and carrying with it pebbles and boulders, is not the correct one to assign to the work performed. There are so many evidences which tend to establish it, both from a mechanical and theoretical point of view, that it would be superfluous here to mention them. They are plainly given in Dana's text-book of American geology, as well as by Professor Tyndall and other writers, who have made the subject a study.

We cannot, however, stop here: there are other features to be accounted for; they are, viz:—The old sea beaches and a local drift, which must have occurred at a more recent period. For, if these beaches then existed, and also the local drift, which I shall hereafter more particularly refer to, any glacial movement must have carried them with it, and deposited them elsewhere in a much more irregular manner than their present appearances would indicate.

I have been considering this matter, and give some notes on the subject for what they are worth.

Every practical miner in our gold fields knows (for every miner in Nova Scotia is also a prospector or searcher for paying-quartz leads on its surface), that if he finds a boulder shewing gold, he will invariably look for the lead or quartz vein to the north of where he finds it, so sure is he of finding the lead to correspond in width and richness as is indicated by the boulder, and that he will exhaust, probably, all his means in the search, or succeed in the find. The direction in which to prosecute the search and the distance, which will vary generally, according to the depth of the drift, is so well understood as to become proverbial.

The quartz boulders are not at all weather-worn, their edges being just as sharp as when broken from the vein or lead (as it is called) to which they belonged.

Let us reject the assumption that the gravel ridges remaining on the top and slopes of the South Mountain are old sea beaches, and for the present call them Moraines, and inquire only into the first postulate, by asking the question: Assuming that there was a glacial movement over the surface of our south-eastern slope, cutting the rocks by a shearing force and carrying them with it, how can we account for the more local movement of the quartz boulders?

These boulders appear on the surface; they may have been broken from their beds by agents such as are now active, viz: the alternating influence of frost and heat.

I know that the frosts of winter will keep boulders on the surface, although they may be again and again covered by silt. I can account for the lifting by the process of freezing. If we could, in this same way, account for the travelling in a southerly direction, which is not so improbable, we might solve the problem of the local drift.

The fact of the distance from the lead being dependent upon the depth of the drift, favors an assumption that in the process of lifting there was also a travelling movement.

It has been remarked to me by very practical observers and searchers, such as Mr. John Anderson, of Musquodoboit Harbour, and Mr. Fraser, M. P. P. for Guysborough County, that miners observe, when costeaning from the boulder northerly, to look for the lead, they frequently find traces of quartz of the same kind, from the boulder on the surface to the lead *in situ*, graduating from one to the other. This fact would go to shew that the upward movement was gradual, and it would not be a great stretch of imagination to assume that, as the boulder was lifted by the process of freezing, it would be forced somewhat in the line of least resistance—i. e., if it was frozen a little firmer on the north side, it might cause a movement southerly. If these facts were more carefully looked into, the local drift might be accounted for.

My greatest trouble is the old sea beaches. I cannot assign their existence to originate from Moraines, because they appear to be of similar constitution to our sea beaches of to-day.

In a paper read by Mr. Gilpin, Government Inspector of Mines for this Province, before the North of England Institute of Mining and Mechanical Engineers, he says:—"There seems to have been two periods of attrition and transportation. The effects of the earlier are now visible in immense "boar's backs" from 50 to 150 feet in height and sometimes a mile in length, following a general north and south course;" and again he says: "A second and more local action is also visible, and by its agency the auriferious veins are usually found. This action has carried the quartzite and slate boulder from 100 to 1800 feet, on a course corresponding very nearly to that of the striæ. Thus prospectors finding auriferous quartz boulders, costean to the North, and frequently trace the boulders to lodes corresponding in every respect to the boulders first found."

If our surface, as is shewn by research, has undergone great and remarkable vicissitudes during geological history, with alternating epochs of genial temperature and snow and ice, the striation and polishing of our rock surfaces may have been effected by glacial action; and subsequently another, and less destructive movement of the same nature, may have taken place which might account for the local drift according to the theory of Mr. Gilpin.

1. Geological.

Commencing at the shore of the Bay of Fundy, we first encounter a thick bed of Amygdaloidal trap, varying in colour from gray to a dull red. It is full of cavities and fissures filled or coated with quartz and other associated minerals. It forms the face of a cliff and rises vertically to a height of 110 feet, and from thence rises gradually with its associated slates and schists, until it attains a height of 595 feet in a distance of three miles; from thence it descends to the Annapolis valley, 345 feet below the summit, within the distance of a mile.

We have now crossed the North Mountain, a narrow ridge not more than four miles wide at its base, and attaining a height of nearly 600 feet, and have reached the Annapolis Valley, which from here to the Village of Nictaux, a distance of 7 miles, is of regular surface, and covered with drift. This latter distance is said to be Trias, or New Red Sandstone, but we could not, within the limit of our observations notice any outcrop which shews sandstone rock *in situ.*

The iron ore bearing strata of the south side of the Annapolis Valley, which are first met at Nictaux, have been described by Dawson as Devonian, but Dr. Honeyman, from recent explorations, is inclined to place them much lower. I am able to place before you some fossils taken from the iron deposits themselves at this place, which may assist in determining the age of the strata here. The slate here has a strike of 45° E. and dips N. 85° and continues up the valley of the Nictaux River to the 15th mile. At the 13th, and again at the 13½ miles the outcrops of some of the Cleveland Magnetic Lodes present themselves. Two at the 13th mile, 5 to 8 feet thick, each are said to be very rich. They run N. E. and S. W. across the line of the mountain-range with a slight northerly dip, and were only two of many which the Cleveland Iron Company have opened up by prospecting. At 14½ miles Smith's Bluff is reached, where the formation changes from slate to granite. Here we encounter a solid bluff of the latter, but for a short distance only. We are now in the granite region. From here to the crossing of the LaHave River, a distance of 28 miles, any visible outcrop met with shews "porphyritic granite."

Immediately upon crossing the LaHave river, at the 43rd mile, there is a transition from granite to slate, which is seen in the beds of the various streams, and in the gravel round Wentzell's lake. The strata has a strike of south, 60° W., and dips northerly at an angle of 80°, the cleavage being nearly vertical.

We are now in the Lower Cambrian formation, or the auriferous region. At 47 miles, at Morgan's falls, the strike is north 63° E., the dip is northerly 87°. At Riversdale, 49 miles, the strike is N., 60° E., dip 87°, N. At 60 miles the strike is N., 65° E., the dip is vertical. At 61 miles we lose the slate in our line of survey, drift, with granite boulders, taking its place, which continues to Bridgewater.

Local Topography.—Bay of Fundy to Atlantic, through Nictaux.

I give the local topography along the line of survey in the words of my report made in the year 1875:

Commencing at the Middleton station, on the Windsor and Annapolis railway, it crosses new pasture land, tillage, orchard, meadow, orchard again, and choice intervale to Annapolis river; thence to Nictaux village, clearings, light alluvial pastures, three orchards, and some spurs of spruce woods. For this distance of four miles throughout, the soil is alluvial and mellow, famous for its great natural fertility, as is all the Annapolis Valley, by producing in abundance most of the grain and fruits belonging to its latitude.

From here the line begins to ascend the western slope of the hill-side of the Nictaux river. Keeping an inclining contour, no serious depression or ravine obstructs the course, which is over an apparently good surface, with occasional outcrops of slate. A mixed growth of heavy timber,—beech, birch, elm, pine, spruce and hemlock—clothes the hillside.

From 6 to 7½ miles, still keeping the same inclination, and following in like manner the contour of hill-side, the same heavy and mixed growth of timber and surface is passed. Here Smith's Bluff is reached, thence to 8.18 miles, where it crosses the Nictaux river, the surface is rough; burnt woods, with some patches of timber still standing, intervene.

From 8½ to 9½ miles, still keeping on the east bank of the river, and still inclining upwards with the same grade, very heavy timber, consisting of hemlock, spruce and hardwood, is passed, as well as some choice farming lands. At the 10th mile we reach the mill-dam of Messrs. Pope, Vose & Co., and from here to 11 miles the surface is denuded of soil by forest fires, and any timber met with is stunted and scrubby.

From 10½ to 12¾ miles, the surface is rough and barren, covered by granite boulders, recent forest fires having destroyed all vegetation; thence to the 14th mile we cross over beautiful intervale soil clothed with heavy hardwood, spruce, and hemlock, Somewhat similar surface and mixed growth of fine timber continues to the head of Waterloo Lake, which we skirt on the east side. From the head of Waterloo Lake, crossing the Halifax road, we soon reach the clearing or pasture land of Mr. John Stoddart, where we attain the summit of the watershed or highest elevation, tract of intervale land growing fine black ash timber.

For the next mile the trial line traverses a meadow, mostly spongy and arid, but with intervening patches of good pasture. At 24 miles, we reach Freeman's Lake, and skirting along its west side, we pass some of the beautiful pasture lands of Springfield, which encircle this lake. From here for 1½ miles, we pass through rocky, barren soil, with a growth of scrubby timber, to Falkland Ridge Road which we cross at 250 feet to the right of the bridge across Beaver Brook. From here to the foot of Mill Lake the surface is principally pasture, with occasional clumps of heavy hemlock. The line here is about midway between the farming districts of Falkland Ridge and Lake Pleasant; the former two miles to the left, the latter the same distance to the right. The soil along the lake is free from rock and well adapted for agricultural purposes, as is manifest by the numerous thriving farms in the neighborhood; thence to the outlet of Mill Lake a belt of soft wood is traversed. At 29 miles we cross the Lunenburg Road and follow the contour of the east side of an open hardwood ridge, sloping steeply towards Mason's Meadow. Soil on this hillside is a light rich loam; the hardwood is, however, soon supplanted by a growth of hemlock and spruce; and the surfaces changes to rough, rocky ledges, until the level of the meadow is reached at 33½ miles. From here to 35 miles sandstone boulders are met for the first time, drifted together with granite and the eastern side of a barren, thence to the crossing of the LaHave River, at 36 miles, we pass through some good timber lands of mixed varieties, and reach a meadow which extends to the bank of the river.

From here we follow the river and public highway along the east banks of Germany Lake, diverging somewhat at Chesley's. From thence to Bridgewater, a distance of 16 miles, the line follows respectively the road and the river; both are in close proximity, the surface regular throughout.

The general character of the surface for the last 16 miles is that of a long, rich agricultural valley, bounded on each side by a continuous line of hills of various forms and surfaces. The timber is heavy, pine is frequently met with ; but the growth principally varies with the varied surface of the land.

The country, so far, sketched along the line of survey, ought to be understood as being local. There are many thriving settlements and farms, not mentioned here, lying in close proximity.

DRAINAGE.

The southern promontory of Nova Scotia lying west of the 64° of longitude, embracing the counties of King's, Annapolis, Digby and Yarmouth, on the north and west, and those of Shelburne, Queen's and Lunenburg, on the south and east, are very marked both as to typography and drainage, extending in a south-westerly direction beyond the 66°, between the Bay of Fundy and the Atlantic Ocean. The South Mountain range of elevated land extending from the Basin of Minas to near Annapolis Royal, in the same south-westerly direction, and from thence converging more southerly through the County of Digby, forms the grand features of the country and regulates its drainage, disposing of its surface water from the northern slopes through the rivers Annapolis, and Cornwallis, which run respectively south-west and north-east to the Basins of Annapolis and Minas.

The Windsor and Annapolis railway found an easy location along these rivers, which traverse the two beautiful alluvial valleys of Cornwallis and Annapolis, famous for their natural fertility.

The physical features of the country south of the South Mountain, are very different to those described on the north side. Instead of the rivers receiving the drainage and running laterally with them, they run at right angles to them, and course nearly parallel to each other. Such are the Gold River, LaHave, Port Medway, Liverpool and Jordan rivers.

The summit of the water-shed is crossed between the Nictaux and LaHave rivers; these rivers here interlace and cross each other in a series of lakes lying in an extensive plateau.

Topography along Annapolis and Liverpool Line of Survey.

We started from the Annapolis and Yarmouth "Interior survey" at a point distant from Annapolis 11¾ miles near Quarry Road, on the east side of East Branch, Moose River. The line follows the course of the stream to the Hessian line road, which it crosses at one hundred and twenty-nine feet east from the bridge. Thence keeping the east side of the stream, and gradually ascending the side hill, with a grade of one in ninety, or 58·7 feet per mile, till it reaches Lake Katy, where it crosses the river at the outlet from lake. Continuing along the east side of Lake Katy to near Virginia Settlement, it crosses the road bearing that name and thence follows the general course of that road till it arrives at Mud Lake, crossing the head of same and thence running direct to the lake known as "Head Waters of Liverpool River." Having arrived at the "Liverpool Head," we were then on the southerly slope of South Mountain, and on the water shed of Liverpool River.

The distance of this summit from Liverpool, in an air line, is nearly fifty-five miles, and the elevation five hundred and sixty feet above the sea. Keeping the west side of lake, crossing Sandy-bottom Brook and Virginia Road, running along the south of the latter for one-fourth mile, recrossing the same, and keeping its north side to Liverpool and Annapolis post-road at Milford, following the road through Milford Settlement; thence along the western side of Long Lake, keeping the general course of post-road, and following the western side of Branch Lake, and the same side of Maitland River to Five Mile Lake, and from here along the western side of Liverpool River we arrive at Millford.

The slopes of the adjoining hills are well covered with heavy timber, pine, spruce, hemlock, and hardwood.

Leaving Caledonia, the line crosses the course of the lake, near the post road, Mr. Moor's farm road and the "narrows" of McLeod's Lake, keeping the valley along same, crossing Smith's mill brook and entering a meadow, distant from Brookfield one half mile.

Leaving Brookfield and taking a south-easterly course, the line crosses Payzant's and Cameron's farm roads, runs close to Christopher's Lake, and crosses Cameron's river, at up-stream side of bridge on main post-road, between it and Bear Trap Lake to a stream bearing the same name, following the westward side of lake to the 45th mile, thence to the western side of Moose Horn Lake, crossing Seventeen Mile Brook at about one half mile from main road, striking Greenfield and Sixteen Mile Settlement road, about two miles from Greenfield.

Thence the course taken continues across Fifteen Mile Brook and through Allen Morton's pasture, about one-fourth mile from Middlefield, meeting the new Greenfield road at a distance of 150 feet from the main road, and taking the east side of the latter to Ten Mile Brook, which it crosses at one hundred and twenty feet from the bridge on post road ; again crossing this road, it strikes the eastern side of Ten Mile Lake.

Most of the ground over which the survey passes in this distance of fifteen miles is almost denuded of alluvial surface.

Continuing along the east of Ten Mile Lake, and the west side Liverpool and Annapolis road, the line crosses the Liverpool River road at three hundred feet from its junction with the main post road ; thence running for and keeping the east side of Liverpool River to Milton. This distance of ten miles is through a well-wooded but thinly-settled country.

Milton, two miles from Liverpool, although having distinct characteristics from the latter, may be considered as an extension of that town, and, judging from the appearance presented by its buildings, as well as the extent and resources of the mill privileges more or less made available for the manufacture of lumber, it is not the less important. The Liverpool River here, for a distance of nearly two miles, is a series of small lakes or pools, impounded by mill dams, and made to pay easy tribute of its strength on its journey.

The mechanical force thus stored and so aptly utilized by the predecessors of the present generation, for the manufacture and export of Lumber, proved so remunerative that comfortable homesteads, nestling in shady nooks, half embowered by trees and sombre woods, remain as a transcendant example of the fruits of industry, skill and perseverance.

SOUTHERLY SLOPE—SOUTH MOUNTAIN.

If we were to follow a course along the South-eastern or Atlantic slope of the South Mountain, keeping parallel with the trend of its summit and lower than the granitic outcrops, we would traverse a district of much interest which is known to few, and would find many places obscure and lonely, possessing great natural beauty and fertility. Along the southernmost slope, this belt, varying from ten to fifteen miles in width, is reticulated by many green patches of foliage and luxuriant growth of timber, exhibiting remarkable contrast with the barren denuded surface of a great portion of the country further down. If you would follow this varied yet regular range of landscape, alternating with lake and woodland, many strange phases of primitive grandeur would present themselves. Some noble forest trees of vigorous growth, some far gone in years, some shattered by the winds and frosts, bent and broken, lying athwart their neighbours, others long since departed yet still bolt upright with their bare white rampike branches atop, and here and there small clumps of new growth shewing all the beauty and vigour of youth. Further on is the "hardwood hill," with its stately white limbed birchen or maple, shewing smooth firm trunks and wide protection of bough, as regular and as trim as if pruned and trained by the expert to beautify some lawn or avenue in the frequented and ornamental parks of Europe. Rising from a carpeted floor of crisp leaves, at remarkably regular distances apart for their convenience of growth and development, these trees, indigenous, clothe receding hill sides for many miles. We notice that the lines are somewhat finely drawn between the domain of each of its kind, each generally keeping within its own boundary. There are, of course, many intervening patches of a mixed growth of pine, birch, maple and others, yet generally speaking, the first named three keep within the zones of their kind. Long vales of meadow, with a copious covering of grasses, frequently are met with. They generally encompass lakes, or border streams on alluvial or peaty surface, and often open up glades that permit the eye to range over a prospect beautiful and extensive. Rosignol, with its clustered islands, secluded and solitary, the largest of our inland lakes, is exceedingly pleasing and picturesque—here expanding into a broad sheet of limpid glow, there presenting narrow wavy outlines in the sombre shadows of islands that look as if afloat, and bearing mast like the spruce and hemlock which give them a trim and characteristic appearance; and again we come unawares on long winding armlets branching and converging with fringed borders of willow and alder, that dip their pendant branches into the water, all giving a semblance of vastness to this natural landscape scenery, that when once seen is not easily forgotten.

The Mic-Mac has for ages established this secluded retreat, commonly known as the Indian Gardens, as the centre of his hunting operations. Here in summer he can provide himself with fish, and in winter he is in the path of the Moose or Elk, that still roam at large and almost unmolested over the vast tract of wilderness. The Beaver, too, is still active in the lakes and swamps along this district, and although his domain, like that of the Moose, is fast becoming circumscribed, he yet furnishes some winter sport and employment to the hunter and trapper.

Art. IX.—Notes on Nova Scotia Fresh-water Sponges. By A. H. MacKay, B. A., B. Sc.

(Read 12th May, 1884.)

About the middle of August, 1883, I spent a few hours examining the MacIntosh Lake, near the north-eastern extremity of the Cobequid range, and the Earltown Lakes, a little higher up on the same range, with the object of learning the nature of the deposits at their bottoms. Having extemporized a small raft on the former lake, I paddled out a little distance, and with my face close to the water, saw old branches of trees in the bottom, with patches of a thick green growth surrounding portions of them, sometimes bearing short finger-like projections. Drawing these up, I made my first practical acquaintance with a fresh-water sponge. On the hard, gravelly beach of a small island in the centre of the lake, I found green sponges branching out four or five inches. The external configuration of this sponge was sufficient to point it out as *Spongilla lacustroides*, Potts, the American form of the European *S. lacustris*, which it much resembles. The deposit in the lake was chiefly composed of the exquisitely sculptured silicious cells of over fifty different species of diatoms to which I shall specially refer in another paper, mingled with a great number of the skeletal and other spicules of more than one species of silicious sponge. Among the plants of the higher orders the waters had an abundant supply of Potamogeton, namely, *P. natans* L. and *Var. prolixus* Koch., *P. praelongus*, Wulfen, and *P. obtusifolius*, Mertens and Koch., and *Naias flexlis*, Rostk, of the same family, and of the Gentian family, *Limnanthemŭm lacŭnosŭm*, Grisebach, with its floating, heart-shaped leaves, while *eriocaulou septangulare* Withering, and *Lobelia Dortmana*, L., studded the shallows. In the Earltown lakes the following were, in addition, plentifully found: *Ranŭnculus aquatiliso*, Var., *trichophyllus*, Chaix, and *Chara fragilis*. Also, near by, in a pond just below McKay's mills, a luxuriant mass of *Nitella flexilis* was found. The altitude of this position will be probably not very far from 1000 feet above the sea level. Mackintosh Lake, which is a little lower, and on the north-eastern side of the water shed, is most easily accessible from Pictou County, near the boundary of which it is situated, a few miles above Loganville, on the West Branch of River John, yet in the County of Colchester. The waters of both lakes are very clear, and the drift around the Mackintosh especially, is characterized by the presence of granite.

I have had but little time to follow out the collection and study of the sponges since the accidental discovery alluded to. I shall therefore throw this paper into the form of notes, or of a report of progress, hoping to be able to give more complete information by the end of another year. I shall now simply describe the freshwater sponge as a mass of reticulated or channelled sarcode, green, when exposed to the influence of the light, supported by a framework of interlaced silicious spicules, about the one hundredth or 12 one thousandths of an inch in length. (See slides, Nos. 2, 3, 5, &c.) In the sarcode is another system of smaller generally cured and tuberculated spicules, averaging from $2\frac{3}{4}$ to 3 one thousandths of an inch. (See Nos. 1, &c.) And thirdly, we have in the statoblasts or reproductive gemmules which are generally formed towards the close of the summer season in the body of the sponge, what are called the *statoblast spicules*, smaller than the others, forming the best basis for classification. I have sent specimens of the material collected to H. J. Carter, Esq., F. R. S., of England, the author of the "History and Classification of the known species of Spongilla," the latest and most authoritative monograph on the subject. Mr. Carter kindly assisted, and sent me specimens of some English and American forms. The following is a summary of what is already known:—

Spongilla lacustroides, Potts.—This species I have found growing abundantly in the Mackintosh and Earltown lakes. It probably also exists in the water supply lakes of Halifax, judging from the appearance of some of the skeletal spicules in their deposits received through the kindness of Professor George Lawson, of Dalhousie College. There is a great rarity of statoblast spicules in the lake deposits examined. This will not be so surprising when it is considered that in the specimens of spongilla collected in August last, of which some dried fragments are here for examination, when treated with acid to destroy the organic matter, only skeletal and flesh spicules are to be seen, as in slides Nos. 1 and 2. Slide No. 5 shows the spicules, all three kinds, of *S. lacustris* from the Exeter River, England, obtained from a portion of a specimen sent me by Mr. Carter. The statoblast spicules are few, more curved, broader than, and not tapering like, the flesh spicules. The corresponding ones of *S. lacustroides* would be less curved. On slide No. 3 are shown the spicules of another species in addition to the first named, which I was suspecting to be those of *S. fluviatilis* from the large tuberculated skeleton spines, and the impression that they had come from a large though not branching sponge which, from the unexpected character of the discovery, I had unwittingly mixed up with *S. lacustroides.* However, I discovered none of its stellbate birotules, and neither Mr. Carter nor Mr. Potts, of Philadelphia, have observed any evidence of the existence of this species in lacustrine deposits sent them.

Meyenia Leidii, Carter.—Slide No. 10 contains the skeletal, flesh and small birotulate statoblast spicules obtained by the acid treatment from this sponge which comes from the Schuylkill, Philadelphia. A few birotules like this have been observed in the lake deposits, from which the presence of the species is inferred. I have not been fortunate in securing one in any of my mounts.

Meyenia crateriforma.—Slide No. 12 shows the spicules of this species, the large hooked birotules being in great numbers. This also comes from the Schuylkill. A few birotules like these have also been observed in the deposits alluded to, but so rare that none happen to be in any of my mounts.

Meyenia Everetti, Mills.—Birotulate spicules, identical with those of this species, are found one in each mount on an average in the Halifax Water Lake deposits, which I received from Professor Lawson. Slide No. 15 contains *one* if not two near the right hand lower margin of the cover. It is smaller than the birotule of *M. crateriforma*, with the shaft quite smooth.

Slide No. 84 contains 14 skeletal spicules of the most common form from Earltown lakes, arranged in the two lower lines of the lower right hand rectangle. Accompanying the slides which explain themselves is a small box with dried portions of *S. lacustroides* and some of the fresh water deposits from both Mackintosh lake and the Earltown lake. The amount of silica derived from these waters and formed into diatom cells and sponge spicules must be very great, as the deposits are in some places very many feet in depth.

NOTE.—Since the above paper was presented, the author has observed *nine* species of freshwater sponges, *(four* genera) living in the lakes of Nova Scotia. Of these, two, viz., *Spongilla MacKayii*, Carter, and *Heteromeyenia Pictovensis*, Potts, are new to science. They will appear in next year's Transactions.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. VI. PART III.

Provincial Museum, October 8, 1884.

ANNIVERSARY MEETING.

ROBERT MORROW, Esq., in the chair.

Inter alia.

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

President—ROBERT MORROW, F. R. M. S.

Vice-Presidents—JOHN SOMERS, M. D.; J. G. MACGREGOR, D. Sc.

Treasurer—W. C. SILVER.

Secretaries—REV. D. HONEYMAN, D C. L.; ALEX. MCKAY.

Council—D. HARRINGTON, M D., AUGUSTUS ALLISON, MARTIN MURPHY, C.E. EDWIN GILPIN, A. M.; GEORGE LAWSON, Ph. D,, LL. D.; WILLIAM GOSSIP, MAYNARD BOWMAN, JOHN J. FOX.

ORDINARY MEETING, PROVINCIAL MUSEUM,
November 10, 1884.

ROBERT MORROW, Esq., *President, in the chair.*

Mr. MURPHY, delegate to the Royal Society of Canada, read the report.

Mr. GOSSIP then read a Paper—"A Retrospect of the Proceedings of the Institute, from the commencement."

ORDINARY MEETING, PROVINCIAL MUSEUM,

December 8, 1884.

ROBERT MORROW, Esq., *President, in the chair.*

Dr. HONEYMAN read a Paper—"Geological Notes of Excursions with the members of the British Association."

ORDINARY MEETING, PROVINCIAL MUSEUM,

January 12, 1885.

ROBERT MORROW, Esq,, *President, in the chair.*

It was intimated that GEORGE M. CAMPBELL and JOHN STEWART, M. D. who had been proposed as members at the November meeting, had been elected by the Council.

THE PRESIDENT exhibited a fine collection of West Indian Molluscas, and made remarks upon a considerable number of them.

A Paper on "Delphinus Delphis," by Dr. SOMERS, was deferred.

ORDINARY MEETING, PROVINCIAL MUSEUM,

March 9, 1885.

WM. GOSSIP, ESQ., *in the chair.*

It was intimated that ROBERT UNIACKE, C. E., who had been nominated a member at the last meeting of the Institute, had been elected by the Council.

A Paper was read by EDWIN GILPIN, F. G. S., on "Feather-alum"—*Malo trichite.*

A Paper was read by GEORGE LAWSON, Ph. D., LL.D., "On New or Rare Plants of Nova Scotia."

A letter was read from the Royal Society of Canada, requesting the Institute to elect a delegate to attend the meetings of that Society on May 19th.

ORDINARY MEETING, PROVINCIAL MUSEUM,

April 30, 1885.

Dr. SOMERS, V. P., *in the chair.*

A Paper was read by Dr. HONEYMAN "On Louisburg—past and present, an Historico-Geological Sketch."

Dr. LAWSON read "Notes on a Collection of Plants,"—by G. G. CAMPBELL. The collection was exhibited.

Prof. J. G. MACGREGOR was elected delegate to the Royal Society of Canada.

ORDINARY MEETING, PROVINCIAL MUSEUM,

May 11, 1885.

DR. SOMERS, V. P., *in the chair.*

A. J. DENTON, who was proposed as a member at the last ordinary meeting, was elected by the Council.

"Notes on Temperature of Maximum Density," was read by Prof. J. G. MACGREGOR, D. SC.

Paper "On New Nova Scotia Fishes," was read by Dr. Honeyman.

"On Freshwater Sponges of Nova Scotia,"—by A. H. MACKAY, B. A., B. SC.

LIST OF MEMBERS.

Dates of Admission.

1873. Jan. 11. Akins, T. B., D. C. L.
69. Feb. 15. Allison, Augustus, *Meteorologist*, Halifax.
77. Dec. 19. Bayne, Herbert E., Ph. D., F. R. S. C., *Prof. of Chemistry*, Royal Military College, Kingston, Ont.
84 Mar. 13. Bowman, Maynard, *Public Analyst*, Halifax.
64. Dec. — Brown, C. E., Halifax.
84. Nov. 10. Campbell, G. M., B. A., *Tutor in Mathematics*, Dalhousie College.
65 Oct. 26. DeWolfe, James R., M. D., L. R. C S., E.
84. April 13. Denton, A. J., High School, Halifax.
82. May 8. Fox, John J., Halifax.
73 April 11. Gilpin Edwin, F. R. S. C., F. G. S., *Gov't Inspector of Mines.*
63. Jan. 5. Gilpin, J. Bernard, M. D., M. R. C., F. R. S. C.
65. Feb. 5. Gossip, William, Halifax
63 Feb. 5. Downs, Andrew, M. Z., *Taxidermist*, Halifax.
83. Mar. 12. Forbes, John, Dartmouth.
83. Mar. 12. Foster, James G., *Barrister*, Dartmouth.
81. Dec. 12. Hare, Alfred, Bedford.
82. April 13. Harrington, D., M. D., Halifax.
67. Dec. 3. Honeyman, Rev. D., D. C. L., F. R. S. C., F. S. A., *Secretary, Curator of Provincial Museum*, Halifax.
74. Dec. 10. Jack, Peter, *Cashier of People's Bank*, Halifax.
60. Jan. 5. Jones, J. M., F. R. S. C., F. L. S., *Halifax.*
82. April 10. Keating, E. H., C. E., *City Engineer*, Halifax.
64. Mar. 7. Lawson G., Ph. D., LL. D., *Prof. of Chemistry and Mineralogy, Dalhousie College*, Halifax.
81. Mar. 14. Macdonald, Simon D., F. G. S., Halifax.
77. Jan. 13. MacGregor, J. G., D. Sc., F. R. S. E., F. R. S. C., *Vice-President, Professor of Physices, Dalhousie Col.*, Halifax.
72. Feb. 5. McKay, Alex., *Secretary*, Supervisor of Halifax Pub. Schools.
84. April 14. McKenzie, Roderick, Bank of Montreal
78. Nov. 1. McLeod, John, Demerara, West Indies.
77. Jan. 13. Morrow, Geoffrey, Halifax.
72. Feb. 15. Morrow, Robert, F. R. M. S., *President*, Halifax.
70. Jan. 15. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 19. Nova Scotia, the Right Rev. Hibbert Binney, *Lord Bishop of.*

Dates of Admission.

79. Nov. 11. Poole, H. S., Assoc. R. School of Mines, F. G. S , *Sup't of Acadia Mines.*

65. Jan. 8. Rutherford, John, Sup't of *Albion Mines*, Pictou.

64. May 7. Silver, W. C., *Treasurer*, Halifax.

75. Jan. 11. Somers, John, M. D., *Prof. of Physiology and Zoology, Halifax Medical Col ege.*

Stewart, John, M. D., Pictou.

85. Mar. 9. Uniacke, Robert, C. E.

ASSOCIATE MEMBERS.

82. Oct. 1. Gunn, John G., *Inspector of Schools*, Cape Breton.

81. Nov. 13 Harris, C., *Prof. of Civil Engineering, Royal Military College*, Kingston, Ontario.

76. Nov. 9. Kennedy, Prof., King's College, Windsor.

71. Jan. 11. McKay, A. H., B. A., B. Sc., *Principal of Pictou Academy.*

82. Mar. 31. McKenzie, W. B., Engineer, Moncton, N. B.

83. Mar. 12. McKenzie, C. H. M. D., *Inspector of Schools*, Parrsboro',

78. Mar. 12. Patterson, Rev. G., D. D., New Glasgow.

84. April 4. Pineo, A. J., *Editor of Canadian Science Monthly*, Wolfville.

CORRESPONDING MEMBERS.

71. Nov. 29. Ball, Rev. E., Tangier.

71. Oct. 12. Marcou, Jules, Cambridge, Mass.

80. June 10. McClintock, Sir Leopold, Kt., F. R. S., *Vice-Admiral.*

77. May 12. Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

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

ART. I.—PAPER BY WM. GOSSIP, ESQ.

(Read Nov. 10, 1884.)

This is a Paper alluded to in the latter part of Mr. Gossip's Report as one of the Delegates of the Nova Scotia Institute, at Ottawa, May, 1883, *and not read at that Meeting of the Royal Society.*

IT will be a consoling reflection to many whose years, like my own, have fallen into the sear and yellow leaf, that they have lived to witness in this young and growing Dominion the formation of a Royal Society of Canada, wherein, as in a mirror, all the grand discoveries of past ages and of the present time, and dependent thereon, the progress of nations in population, wealth and prosperity may concentrate, as examples and incentives towards a diligent and industrious emulation in a further patriotic course of public inprovement.

Much, however, will depend upon the direction that is given to the impulse thus communicated. If it serve only to inflate the mind with exaggerated ideas of personal importance, the Royal Society may become a distinguished ornament of the Dominion, but much good may not be expected to flow from it in a national point of view. In fact it might as well be dead. But if the impulse spread itself, and be made to permeate the community with the usefulness which is undoubtedly a part of its nature, it cannot fail to awaken the dormant or latent talent of the country, and infuse amongst its enquiring minds the energy of robust life and active research. The benefits derived will then be great and manifold, commensurate with the utmost hope and expectation entertained by the friends and well-wishers of the Institution.

Nor is there any reason, in all that has yet been done on behalf of the Royal Society, to anticipate aught else than a happy result of its labours. Certainly it has rarely been on this side of the Atlantic that a learned association has been introduced to a community under more exalted or more favourable auspices. It will go down to posterity as a worthy conception of the Representative of Her Most Gracious Majesty, her son-in-law, a noble Governor-General, anxious for the advancement and prosperity of a country whose interests were committed to his charge—a country than which none other on the face of the earth possesses in a greater degree the elements of national greatness. With his name also, as its founder, must ever be identified, that of his royal consort, the Princess Louise, whose august presence among us is an evidence alike of the confidence of the Imperial Government in the unswerving loyalty of the Dominion, and of the parental reliance of the Sovereign *on our zealous affection towards her person and government.* Various, therefore, as may be the nationalities of which our country is composed, more emphatically than ever may we now claim Great Britain as the *Mother Country,* and under the ægis of her unrivalled constitution combine to work out to their fullest fruition all those political, commercial and national advantages, which have so freely and lavishly been bestowed upon us.

With a centralized Institution like the Royal Society, so well calculated to promote the advancement of science, it would be a remissness of the duty we owe to ourselves, if the Nova Scotian Institute of Natural Science failed cheerfully to respond to your invitation to unite with you and to lend its aid to facilitate and promote your high objects. When, therefore, with a true liberality which did you honour, and was perhaps expected, you held out the right hand of fellowship, and so deigned to endorse our humble labours, we hailed it as a formal recognition of the brotherhood of science, not limited by colonial or national boundaries, but expansive as civilization, and wide as the world. We felt glad of your desire to affiliate, and I am here to-day to show to you that we rejoice in your brotherhood. It may not, therefore, be out of place, being one of its oldest members, and with your permission, if I devote a few short sentences to inform you of our origin and history.

The Nova Scotian Institute is placed by you among the chief scientific associations of British America, although but little more than twenty years in existence. Short, however, as its time has been, it may be said so far to have done good service.

The Institute originated with a few gentlemen who believed that in a Province which contained vast mineral resources, and further was an untrodden field in other branches of natural science, there would be found men of culture and experience who would gladly lend their aid to develop them into successful activity. After several meetings in the office of Mr. Robert Haliburton (well known in this city, *i. e.*, Ottawa) the Institute was organized and the officers appointed. This was in January, 1863. Our first President was Mr. J. Matthew Jones, F. L. S., an English gentlemen who had acquired some distinction as a naturalist. I became its first Secretary. The Provincial Government gave us the use in the Province Building of the only spare room at their disposal. The first or second meeting (I forget which) was attended by His Excellency the Earl of Mulgrave, Lt.-Governor of the Province, and since Governor of Queensland, and more recently has succeeded to the hereditary title of Lord Normandy. He made an excellent speech, commendatory and congratulatory of the enterprise, which I regret to state has not been recorded in our Transactions. The inaugural address was delivered by P. C. Hill, Esq., more recently the Premier of the Nova Scotian Assembly. In the first volume of our transactions, embracing a period of four years, will be found papers on the Provincial zoology, geology, mineralogy, ichthyology, gold fields, ethnology, conchology, lepidoptera, meteorology, and other branches of science, to which I need not more particularly allude. Coming from a country so little known as Nova Scotia then was, this volume seems to have commanded considerable attention, and applications from scientific societies abroad were frequent for exchanges with their own publications, and soliciting correspondence. These were responded to so far as we were able until now most of the earlier volumes of our Transactions have been expended. We thus early realized the anticipations in the inaugural address of Mr. Hill, who, after some preliminary remarks on the value of well organized over individual efforts, modestly observed :—"Should our hopes not be disappointed, we look forward to the time when our 'Transactions' shall be exchanged with older and more important institutions, and any new or well authenticated fact having passed the ordeal of our own local organization, shall be submitted to the great centre of science, and become the property of the whole world."

But it was not so much the early accomplishment of the result thus anticipated, as a conviction of the Institute, that it was within the scope of the talent and ability of its members to command attention both at home and abroad, and to enter upon a high career of usefulness whenever they choose to bestir themselves. They lost no time in doing so. The inaugural being disposed of, the first scientific paper, appropriately devoted to practical zoology, was read by Dr. Bernard Gilpin, a naturalist, well known in British America and the United States as the Nova Scotia Zoologist. He furnishes an exhaustive description of the herring of our coasts, *clupea elongata*, and its peculiarities and species, which leaves nothing to be desired. In further numbers he enlarges upon the Zoology of Nova Scotia, and to all who are curious or desirous to be instructed in such matters, he has so identified himself with the natural history of every fish, bird, reptile and mammal of the country, and so accurately described and illustrated them, that future writers or readers will require no other guide on these branches of the subject. This first paper was read Feb. 2, 1863.

Other papers followed in rapid succession, to wit:—By Capt. (now General) Hardy, "On Nocturnal Life of Animals in the Forest;" further on, "On the Caplin, *Mallotus Villosus*," of which he gives a most interesting and animated description. By this paper the fact not hitherto settled was established, that the southern limit of this ancient fish, an inhabitant of the deep in the days of the tertiary period, and found fossil near Montreal, is the coast of Nova Scotia, which it frequently visits. By Thos. Belt, who was afterwards distinguished as "the naturalist of Nicaragua," "On Some recent Movements of the Earth's Surface." By Henry Poole, Superintendent of the Albion Mines

Pictou, a position now filled by his son, "On the characteristic Fossils of different Coal Seams in Nova Scotia." By J. Matthew Jones, F. L. S., "Ichthyological Contributions." By Abraham Gesner, M. D., a well known geologist, "On the Gold Fields of Nova Scotia." He was followed by Robert Haliburton, a gentleman almost as well known to science in Canada as in Nova Scotia, with an able scientific paper on ethnology, or perhaps, as more appropriately styled by himself—"ethology," in which he appears to have re-discovered a long hidden and crude system of astronomy, which was known before a knowledge of the solar system, or had derived its origin independent of it, and when the human mind could yet scarcely comprehend the principles by which it was governed. However that may be, Mr. Haliburton pointed out that the influence of the pleiades was coeval in the minds of many branches of the human family, and that religious observances among the most ancient of the tribes of mankind, depended upon their rising and culmination. Of these religious observances, relics still remain which seem to be ineffaceable, for instance—the Festival of the Dead. All Souls, All Saints, Halloween, the Mormodellick of the Australian savages, and other far fetched heathen festivals, all occurring at or near the same time of the year. This paper of Mr. Haliburton's, which I commend to the careful perusal of every member of the Society interested in the subject, commanded much attention from learned men, and was I believe mainly instrumental in making our Institute better known abroad. I am not sure that it may not form one of the best arguments of a certain school of ethnologists, on behalf of the plurality of the human creation, on which a great deal has been already said, and a great deal more remains to be said and written. Or that it may not point to the original site of the human family so imperfectly described in the Hebrew Scriptures, which had been utterly destroyed by a flood, but which may have had colonies far from the scene of destruction of which there are only a few remnants at the present day to attest to a very early intellectual progress and civilization.

There is no necessity, however, that we should indulge in such speculations, and it may create some astonishment that a young Institution should challenge public attention by so bold a flight and in a spirit of deprecation I may say that it has not been frequently repeated, and that only in a few instances have we gone beyond our own Province for material to form the subjects of our Papers.

As a member of the Ethnographic Section of the Nova Scotia Institute, however unworthy, I could not refrain from a particular notice of Mr. Haliburton's excellent Paper, of which we have so good reason to be proud. The Ethnology of our own Province is, however, a very attractive subject, and is of considerable importance in connection with the history of mankind. I will shortly refer to it in connection with the aborigines of Nova Scotia. It may not be quite satisfactory to some who incline to the belief that varieties of mankind were created on this continent, that it can be shewn that the Micmacs are not autochthones although I believe they are lineal descendants of the earliest forms of mankind, and amongst the first emigrants from the site of their creation, as they are probably the latest, though almost completly separated, Algonkin emigration from the oldest settlements of their tribe, with whom they afterwards maintained a desultory acquaintance. With the restless spirit of their earliest wanderings they were in search of a better country, or they may have been driven off by war or intestine commotions. They undoubtedly came to Nova Scotia by way of the river and Gulf of St. Lawrence, and reached first Prince Edward Island, and settled themselves. They then spread to Cape Breton, where they still continue a wandering race, and must have crossed early to Newfoundland, where they came into contact with the Boethicks, with whom they were continually at war. They thus at length found the better country they were in quest of, and the peaceable land they sought, to which they gave the name of Acadia, which means in their language, " the land of abundace." They may have inhabited and prospered in it and multiplied, at least one thousand years before the arrival of the Europeans in America.

I have never been able to discover whence the tribal name of

Micmacs was derived, and have reason to believe it is not a proper designation. If there are Irishmen and Scotchmen in this assemblage, they may by putting their heads together be able to guess at a solution of the problem. I once asked an intelligent Squaw the question. She did not know. "They were becoming so mixed that no one knew." A more ancient and euphonious name for them is that of Souroquois, which has a French sound, and certainly divides the honours with that of *Micmac*. I believe that neither is correct. Neither can it be "Mignog, which some suppose it to be." I have never been able to discover it from the Indians themselves, who inherit little or no traditions except some legendary ones. In conversation once with an intelligent Micmac I asked him how they came to be called by that name The question seemed rather to puzzle him for a moment, and he replied by asking another, "How you come to be called *Blue Nose?* Micmacs, I suppose, come in same way." Then, said I, you are not Micmacs? "Not very much." said he. The Rev. Mr. Rand, of Nova Scotia, a Baptist Minister, than whom no one alive is better acquainted with our Indians, who has lived amongst them, preached to them, and done all he could to improve their morality, and make them adopt more civilized habits, replied as follows to a question I submitted to him on the subject :*

Perhaps one cause of his failure to influence them may be that they are staunch Romanists and will not be otherwise persuaded.

There is no direct evidence from which to prove the extreme antiquity of the Algonkin race; but the man himself and his works are before us from which to deduce the fact. His natural colour is that of *the* Adam, and remains unchanged, except through intermixture with other races. He lived in a rude camp or wigwam made expressly for removal from place to place, and never intended for permanent settlement. He is a hunter and fisher, and a wanderer from the beginning, and may have com-

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NOTE.—I regret that the letter of Rev. Mr. Rand, replying to my question, has gone astray since the copy of this paper was prepared and furnished for the press. So far as I can recollect, it implied that the tribe were very *strong men —head crushers—could beat all creation*. and gave the true tribal name as *Buctowege*—which has much the same signification, and may be translated as "strong drink," the strength of which, unfortunately, the Micmacs are too fond of proving.—W. G.

menced his journey northward for aught we shall ever know, in the second generation of the human family. He made his utensils and his weapons out of wood and stone after the most simple process when he had attained to it. The hammer, the knife and the tomahawk must have been to him masterpieces of adaptation and human ingenuity. The spear, the sling, and bow and arrow followed, and were his weapons of offence and defence, upon which he mainly relied to procure sustenance. In these he gained some mechanical proficiency, but never was much of an inventive animal. The stars guided him to his destination and the chase supplied his wants. He learned to fashion a canoe, rude enough it must have been in those early days, by which, however, he crossed lakes and rivers, and frail as it was, and is, became an adept in its management, and at last adventured on a sea voyage, but he never understood the principle of the keel or the rudder. With the canoe however, he was equal to any fate that might befall him, and it were doubtful if he could have reached this continent without it. I believe that he was the first human being that arrived on the northern part of this western land, and having no enemies to contend with, and plentiful sustenance, he increased and multiplied, and became at length what the Algonkins are at the present day, the most numerous of its aboriginal families. He, that is his ancestry, left the site of man's creation evidently before cattle were used by man, or beasts were subdued to his training.

One of the best evidences of the vast antiquity of the Algonkin race is the comparative purity of their religious belief, which must have been also that of *the* Adam, of Enoch, of Noah. They worshipped the Great Spirit, the Author and Controller of all things, and added to their creed the doctrine of the immortality of man's nature. True, in the course of the many thousand years of his development, his simple nature has been imposed upon by crafty and designing contrivances of his fellows, who have perverted his imagination by attributing to themselves supernatural powers, and complicated his belief, by grotesque and hideous ceremonies ; but he has never lost sight of the pure theism, which had impressed the minds of his remotest ancestry, and his dependence upon one God, the Supreme Being, the great Father, is still paramount, the foundation of his reliance in life, his chief consolation in death.

Such is our Algonkin, and with this very imperfect sketch I leave him with the ethnologists of the Royal Society as an interesting study, which, if carefully followed out, may throw some light on the conformation of the western continent; and the history of the aborigines which inhabit its northern portion

Nova Scotia cannot produce exclusively, original types in any department of Natural Science. It is only within a comparatively recent period that gold has been added to its mineral resources, but this is found in similiar strata and under the same conditions as in other lands. Fortunately for us, its workings are of vast area and fairly remunerative. The coal and gyspum of the country, which are so well known and appreciated, are of carboniferous age and practically inexhaustible. Indications of other metals are frequent, but they do not appear in such quantities, as yet, that we would like to pin our faith on their extent and value. The iron ore of Nova Scotia, which is no recent discovery, but not unlimited, is of great extent and of the most valuable description. After all it is upon our iron and coal that the chief reliance can be placed for our mineral contributions to commerce. Much depends upon a careful geological and mineralogical examination of the country, and the one ought to accompany or immediately follow the other, and cannot be too exact. It might have been expected that long ere this the question would have been settled. I would recommend the writings of your President, Dr. Dawson, and those of our Provincial Geologist, Rev. Dr. Honeyman, as the best authorities upon the subject.

Nova Scotia is a country of no vast extent, but sufficiently large to afford the best examples of the geology and mineralogy, the zoology and botany of the Dominion, and is replete with the rare but as yet inert resources that contribute to the study of natural science and art. It is fairly entitled both to the consideration of the government and people of the Dominion, with a view to encourage and call them into useful activity. We ought therefore, to expect great things from an alliance with a Royal

Society which is so patronized and upheld, that it may almost be deemed a Government Institution. at the same time while it is so distinct. as to prove that its chief support must depend upon an appreciation of its merits by the people. Hitherto whatever has been done in this respect has been with little or no extraneous aid and assistance. Take our Institute as an example. After very creditable progress, and increasing popularity for several years, the pressure upon its funds for necessary maintenance had become so severe, that an application had to be made to the local legislature, which granted a small annual sum, then, and still, very acceptable, which enables us to look the Province in the face with a creditable annual Book of Transactions, and in this way to repay the obligation by making the country better known both at home and abroad. But we are still indebted to the generosity of individuals for a place wherein to hold our meetings. and a place to keep our library, which is becoming valuable in many original publications. We are not able to build a hall of science as was sanguinely contemplated, nor are we able to procure out of the funds at our disposal, such publications connected with our object, as we would like to call our own. I do not affirm that the interest has abated which was inspired at the birth of our Institute, certainly it has not beyond the confines of Nova Scotia. but with the strain upon the knowledge and the active intellect of our members, it is rather wonderful that their energies have proved equal to the demand upon them, or that its meetings are regularly held. It may be within the bounds of probability that the Royal Society, as a head or central Institution, with a position so well secured and acknowledged, may be able to supply by its influence just the momentum that is so much required to remedy some of those defects. Most likely our case is that of all Provincial or Canadian societies affiliated with it. They will without doubt desire to preserve their independence in their separate Provinces, and all alike deserve consideration. It may not be right therefore that the aid of the Government should be bestowed on one Institution exclusively, but a discriminating assistance to all might be afforded through one well recognized channel, to be claimed as required, by proper application and well proved necessity. I throw out the suggestion for what it is worth. Something of the kind is required to secure the proper control and efficient working of the Royal Society, and I hope for it a fair degree of attention.

I might enlarge upon other matters favorable to ourselves and to similar efforts elsewhere, but neither time nor opportunity serve at present for more extended observations. I will remark, however, in conclusion, that the Dominion, with regard to every element of national progress, occupies a proud and enviable position amongst the nations of the earth. We reckon up our ancestry from the Norman conquest, without much thought of the wonderful Providence which has consolidated the nation, and guided it through the chaotic and brutal ignorance of that early period, to the contrast of its present proud rank and development, at the acme of civilization and refinement and progress in art and science of the nineteenth century. How unmeasurably superior is our position. To us the offspring of all the nationalities of our remote ancestry, whose blood is commingled with that of the Saxon, the Norman, and the Gael, the habitants of an hemisphere of which no knowledge then existed, is the fusion bequeathel which has made us all Englishmen and Britons, and developed the greatest nation the world ever saw. We are the heirs of all their progress, to mould the future of this vast Dominion,—not to rest here,—but to carry it onward to a far greater expansion. "*No pent up Utica contracts our powers.*" The vast extent of our country and its surprising fertility. Its settled constitutional government and perfect freedom. Its healthiness of climate everywhere. Its frontage on two oceans so favorable to commerce. Its mineral and finny wealth,—are all bases of advantage which point to a glorious destiny. It needs no spirit of prophesy to foretell the result if true to ourselves. We have already an earnest of progress towards that end, in the spread of our manufactures fostered by an enlightened government—in the liberal institutions which are conferring their blessings on the land and helping the consummation—in our Royal Society and cognate institutions, under the highest auspices and brightest prospects. As we cherish these and apply to them our powers of body and mind, so shall we aid the accomplishment of our destiny and become at length what God and nature have manifestly designed us to be—the chief nation of the western hemisphere, perhaps the leading nation of the world.

Art. II. — Geological Notes of Excursions with Members of the British Association, and others. By Rev. D. Honeyman, D.C.L., F.R.S.C., F.S.A., &c. *Curator of the Provincial Museum.*

(*Read December* 8, 1884.)

When accompanying our visitors of the British Association, I made several observations which seem worthy of record.

JOGGINS SECTION.

We first examined the South Joggins Section—the middle carboniferous division. This section is always interesting, as every season makes a renovation. We were, however, too late. Any fossil trees which had been exposed in the early part of the season, had been removed by Mr. Barnhill and others. A part that is always striking had thus disappeared. Interesting specimens of stigmariae, with rootlets, lepidodendra, sigillaria and calamites, were observed among the *debris* of the cliffs and in the ledges. Seams of coal and shales with *anthracosia* and *entomostraca* were also examined and specimens collected. Want of time prevented us from visiting aud examining the grindstone grits of Lower Cove.

Interesting sections of trees, sigillaria and lepidodendra, were also examined at the Superintendent's residence, with small collections of fossils, containing large scales of rhizodus and other ganoids, with ferns and other flora. These had been secured by Prof. Richards, of the Massachusetts Institute of Technology.

SPRING HILL AND PARRSBORO' RAILWAY.

Beginning at the Springhill Mines Station, we were in the "middle carboniferous" formation and of the synclinal to the Joggins section. Proceeding, we passed into the red sandstones of the lower carboniferous. At a distance of about 11 miles, we seemed to come to the end of this. I expected as much, from the proximity of the line to a road and river section that I made from Spring Hill to Five Islands. *(Vide Paper, year 187–.)*

From this onward, to a distance of about four miles, all is obscured by drift. From the analogy of the section just referred to, as well as for reasons which I shall adduce in the sequel, I consider that the underlying rocks are Archæan. In the other section, lower carboniferous conglomerates come in contact with the granites without the intervention of other pre-carboniferous formations. The I. C. R. section has the Wentworth series, which I consider to be of lower silurian age, intervening between the lower carboniferous and archæan. *(Vide Paper 1870.)*

Proceeding I observed outcrops of rocks to the east of the railway, and masses of rock even on the line, which are evidently metamorphic. On the other section, near Five Islands, we have 2½ miles of metamorphic rocks, which I regard as silurian, and as probably the extension of the Londonderry ferriferous series. Underlying Parrsboro', we have probably the extension of the Harrington river rocks (Five Islands), which produced carboniferous *flora* and *fauna*.

PARRSBORO' AND PARTRIDGE ISLAND.

In a walk along the road I had an opportunity of examining a carboniferous series, which is considered to be synclinal to the preceding. The upper beds of these, which are thin sandstones, and grey and black shales, have a northerly dip in 75° and an east and west strike—they are seen crossing the road below Parrsboro'. They are, therefore, synclinal to the Parrsboro' series. The outcrops on the road farther on seem to have the same high dip. The shore sections east and west of the pier, are evidently of the same character. In some of these—a red sandstone—Mr. Gilpin found carboniferous fossils,—*shells*. I was surprised to find them where I expected to find Triassic Sandstones. On the shore section east of Parrsboro', these were seen and distinguished by their bright red colour. These were also observed to the west of Cape Sharp. The intervening part of the formation has been evidently obscured by glacial and post glacial marine denudation.

PARTRIDGE ISLAND.

This island, or rather peninsula, is very interesting. Walking over the rocks, we found the tide conveniently low, so as to enable us to compass it. The east side is basaltic and bold, —some of it having a "causeway" aspect. Numerous veins are seen permeating the basalt. These are generally jaspideous or chalcedonic; some appear to be magnetite,—a specimen was found among the basalts. At the point the rocks are split, so as to form an easy passage to the western side, when the tides are rising. On this side the rocks are more interesting to the collector. They are amygdaloids, &c., and other traps, replete with minerals in veins, gledes and amygdules. Here we collected beautiful specimens of minerals and amygdaloids—the latter for the purpose of comparison—with boulders, in the drift of Halifax and other places. Coming to the north side, we saw a fine section of triassic sandstones. They were seen to dip towards the eruptive rocks, and at the junction to be overlaid by them. They were thus dipping in a direction contrary to the carboniferous of the shore. This may be considered a continuation and a termination of our section.

PASSAGE FROM PARRSBORO' TO WINDSOR.

On board of the steamer "Hiawatha," we made further observations. Clearing Partridge Island, we observed Cape Sharp, with its triassic and eruptive rocks. Easterly in the distance was seen Cape d'Or, having an insular appearance in consequence of a mirage. Succeeding was Cape Split, with its fantastic peaks, and the grand ridge of eruptive rocks ending in Cape Blomidon. The day was exceptionally clear, so that distant objects could be seen with great distinctness. Blomidon was beautiful, with its great stretch of underlying bright red triassic sandstones, overlaid and crowned with dark basaltic and other trappean rocks. Rounding the cape, we admired its noble profile ; proceeding, we viewed its triassic sections onward to Grand Pre, without difficulty. These sections represent the triassic formation of Cornwallis and Annapolis Valley. From the occurrence of the same formation on either side of the Basin, and to the eastward, as well as from the sections just referred to, we can safely infer that this formation extended, or yet extends, from Parrsboro' to Grand Pre,—a distance of 15 miles. The sections on the shore may therefore be added to our section. Approaching the estuary of the Avon, attention was directed to the interesting section of lower carboniferous strata called Horton Bluff. Great outcrops of gypsum were observed on the right, and Cheverie triassic and lower carboniferous on the left.

WINDSOR.

Reaching Windsor we examined the interesting lower carboniferous section above the old Avon Bridge. Attention was first directed to the fossiliferous limestones, and the outcropping gypsum. Here very fine masses of selenite were found. Dr. Blanford observed the abundance of trappean boulders, and supposed that there must be a dyke in the neighborhood. Being assured that these amygdaloidal and otherwise were transported, he regarded Partridge Island as the source of supply. The abundance of associated boulders of crystalline rocks confirms the supposition. I will give the reason why.

I had not examined these since I commenced my investigations in glacial transportation. I did not remember of the occurrence of any other than amygdaloid boulders. I had observed amygdaloid at Blomidon, and had referred the amygdaloids in the drift of Halifax, &c., to Blomidon.

The boulders of other crystalline rocks, such as syenites, diorites, &c., now observed at the Avon section, associated with the amygdaloids, basalts, and other trappean rocks, shew transportation from the Cobequid Mountains, beyond Parrsboro'. Partridge Island, being in their course, could not escape a levy any more than Blomidon, so that we may consider both as sources of supply of amygdaloid and other trappean boulders. The glacier may thus be credited with facilitating the construction of the

Springhill and Parrsboro' Railroad by excavating in part the passage through the Archæan and other formations, and also with furnishing ballast by the deposit of the obscuring drift. In this connection, I would observe that it may have had something to do with the formation of the great Boar's Back of Hebert River. This deposit is 7 miles in length.

GYPSUM QUARRIES.

We were conveyed to the extensive Gypsum Quarries, east of Windsor. The exposure of gypsum is truly magnificent. How or by what process these and similar deposits came into existence has certainly yet to be discovered. There is a large amount of Anhydrite, as well as hydrous gypsum. The first is bluish in color—a use for it is yet to be ascertained. The useful gypsum is white, and is principally used as Plaster of Paris.

The borates (mineral) is a discovery of the late Professor How in these quarries. Specimens were collected. His representative collection is in the Provincial Museum.

On our way boulders of amygdaloids, crystalline rocks of the Cobequids, were observed on the road side.

We left Windsor by the Railway Train at night and travelled to Halifax. As the rock sections of the Railway could not then be observed, I will describe them in inverse order from my Paper "On the Geology of the Gold Fields of Nova Scotia."—*Quarterly Journal of Geological Society, 1863.*

We have (1) the Newport Gypsum (of the quarries visited); (2) half a mile of Lower Carboniferous Sandstone (underlying the Gypsum). This is unconformable to (3), quartzite (Cambrian of our Gold Fields), which extend 2½ miles. Then come (5) Argillites (of the same formation). These extend 2½ miles. Following (6) are cuttings of Quartzite to about a distance of 2½ miles. We next have (7) Granites of Mount Uniacke; these extend to a distance of about 4 miles. In this there is a quartzite parting. A farther distance of 1½ miles are quartzite cuttings. We have now reached 12 miles from the Junction. At Beaver Bank, the station next the Junction, are Slate Quarries. At the Windsor Junction the Quartzites appear in great prominence. Here we have the extreme of the Waverly Gold Field. From this to Halifax Station we have Quartzites with Argillites The latter connect with the Quartzites at Richmond. These Argillites extend beyond the Station through Halifax City to Point Pleasant.

MONTAGU GOLD MINES.

At Halifax our Party received large additions by the arrival of several other members. We next visited the Montagu Gold Mines, near Halifax. On our way a subject of conversation with Dr. Blanford and Mr. Topley. was the age of the gold bearing rocks. When the Gold was first discovered the geology of Nova Scotia and New Brunswick had not attained to its present state of development. The only fossiliferous rocks with which they could be compared were the Middle and Upper Silurian rocks of the "Arisaig Series." The high metamorphism of the gold bearing rocks when compared with that of the others, and the fact of the existence of gold in quantity seemed conclusive of their Lower Silurian age. *Vide* my Paper " On the Geology of the Nova Scotia Gold Fields."—*Journal of the Geological Society, 1863.*

Since then the *Archæan* and *Hudson River* of Arisaig have come to light, as well as the *Archæan* and *Cincinnati or Hudson River*, of Wentworth, of the Cobequid Mountains, the *Archæan and Upper Lingula Flags* of Cape Breton, and the *Archæan and Lower Lingula Flags* or Primordial of Saint John, New Brunswick, and yet no *obvious* equivalent of the gold bearing rocks have appeared. We have consequently been led from this and other considerations to look to Wales for their equivalent, and consider that we have found at least an *approximate* equivalent in the gold bearing rocks of the Dolgelly district, *i. e.*, the Cambrian or Pre-Lower Lingula Flags. In this, as at Arisaig, we would adopt the late Mr. Salter's advice, in consequence of distance, to use the qualifying term *approximate. Vide* Paper " On the Geology of Halifax and Colchester Counties, Part I."—*Trans. Institute, 1882-83.*

One of the Mines, the Bluenose, or New Albion, was particularly examined, the position of the auriferous vein, its character, its gold and mode of occurrence, as well as the process at the mill by which the gold is extracted. Gold was seen occurring in a striking manner in a collection of pieces of quartz taken from the mine. Of these the visitors received a liberal share, as *mementoes* of Nova Scotia Gold Fields.

POINT PLEASANT.

Dr. Blanford, Messrs. Bauerman, Topley and Merrit, the geologists of the party, and Mr. Morrow, the President of the Nova Scotia Institute of Natural Science, went to Point Pleasant to examine interesting glacial phenomena. As the weather was unfavorable, we could only examine a few of the more striking of these.

1. We first examined a ledge of the Cambrian rocks on the east side, near the Point. This projects into the harbour. The strata have a northerly dip of 20°. The rocks are hard and crumpled. They have been scooped, grooved and rounded. The course of striation produced passes through the harbour, touching Thrum Cap, a remarkable glacial deposit which was examined in company with Col. Akers, R. E. I have characterized this as "The *ultima thule* of Glacial Transportation in Eastern Canada."—(*Vide* Paper "On the Geology of Halifax Harbour," read at the meeting of the British Association at Montreal.) It was suggested that the glaciating agency might have come from the south. Another glaciated surface to be yet examined was referred to as shewing the direction.

2. The section of a deposit of glacial drift at the west side at the entrance to the N. W. Arm was next examined. Numerous boulders were observed. These were syenites, diorites and porphyrites, from the Cobequid Mountain, Archæan series of rocks, and of the Springhill and Parrsboro' Railway. Attention was then directed to an enormous boulder of quartzite of Bedford Basin or beyond. This is furrowed, rounded and striated in a remarkable manner—two sets of furrows forming a series of various angles. This was at once recognized as part of the plowing machine which had furrowed, striated and polished the rock surfaces of Point Pleasant. The boulders of our section is still partially imbedded in the drift.

3. I next directed attention to a sizeable boulder which Prof. Richardson had taken out of the drift with his pick-hammer.

Dr. Blanford at once recognised it as a Partridge Island Amygdaloid. The boulder is replete with beautiful Amygdules of the Zeolites, Heulandite, Stilbite, &c. The remains of it will be found in our Museum Collections, where it is treasured as a memento of pleasant intercourse with British and American Geologists.

PRINCE OF WALES' TOWER.

Our next and last object was the very remarkable, unique, and instructive, I may say classical, glaciated rock area at the Prince of Wales' Tower. This has called forth the admiration of every Geologist who has examined it. Here we have a rock surface generally smoothed, polished, striated and rutted in the Glacial Period after having been tilted "wonderfully crumpled and faulted," in the very remote Lower Silurian past.

The most striking and instructive part of it are its ruts. These convincingly reply to the question asked on the Harbour ledge (1). A series of these are seen beginning at the northern side of the area. After rutting the edges of the striata, in the manner of a nail drawn across the lines of growth of a pine board, they come to a close set line of crumples. Here the ruts terminate, only a few short scratches pass beyond the crumples, diverging from the regular course S. 20 E. mag., at various angles. This convincingly shows that points of the graving machine making the ruts had been fractured in their southerly course. This testimony corresponds with that of the transported Amygdaloids. The rut course produced in a northerly direction passes the line of Blomidon, and crosses to Cape Sharp. A parallel glaciation, course S. 20°, E. mag., from Gore and Shubenacadie, on the east, includes Partridge Island and Two Islands. The two still farther produced pass through the Cobequid Mountains, including the depression through which the Spring Hill and Parrsboro Railway passes, and terminate in Nova Scotia at the South Joggins Section, the latter two miles west of the Joggins Mines' Coal Seams, the former 12 miles farther west at Sand River. Produced farther they pass into New Brunswick, including the "Pre-cambrian" mountain, Shepody.

Previous to the meeting of the British Association I had the pleasure of examining the phenomena of Pleasant Park with the other members of the Association. Mr. Blair, of Oakshaw, Paisley, and the Rev. Father Kavanagh, S. J., now of Quebec. As the weather at this time was more favourable a more extensive and minute examination of the locality was effected. The "Geology of the Harbour" was pretty fully discussed with these Geologists in anticipation of the reading of my Paper on this subject, forwarded to the Secretary of the Association, Prof. Bonney. Specimens of rocks and glacially transported boulders were collected. One boulder was of a beautiful Diorite-Porphyry, from the Cobequid Mountain Archæan series of rocks. Of this Father Kavanagh has made an exquisite section and forwarded it to me for examination with the Polariscope and Microscope.

DESCRIPTION.

The ground mass consists of Hornblende with microscopic Plagioclase. The latter is amorphous with minute crystals, which are often in twins. Some parts of this mixture is beautifully pleochroic with the dichroism of the hornblende and the trichroism of the feldspar. Other parts are darkened with opacite which the microscope with direct light shews to be chiefly magnetite. The Plagioclases separated from the ground mass so as to make the rock porphyritic is strikingly pleochroic. There are only two rocks which I have previously examined, one from Sundy Point, Yarmouth, another from St Peter's Canal, Cape Breton, that exhibit an equal variety of colours, bands and striae. Some of these crystals include magnetite. The Feldspar in this and the other sections has a different spectrum from that of the Labradorite of the Blomidon Basalts and the *albite* of the Arisaig Archæan Diorites and the Nictaux and Wentworth igneous diorites. I have *supposed* this form of Plagioclase to be *oligoclase.*

I have derived much pleasure and profit from this intercourse with "Brother Hammerers."

ART. III.—FEATHER-ALUM (HALOTRICHITE) FROM GLACE BAY, CAPE BRETON. BY E. GILPIN, F. G. S., F. R. S. C., CHIEF INSPECTOR OF MINES.

(Read March 9th, 1885.)

DURING a visit to the Glace Bay Coal Mines, in Cape Breton County, I had specimens of Melanterite, or Green Vitriol, and a few pieces of a white fibrous mineral brought to me from some heaps of shale and slack coal, which were being removed from the pit. The former mineral is not unfrequently met with, the latter being new to me I made two analyses of it, and thought that the results might interest some of the members of the Institute.

The mineral is of a white colour, turning brown on exposure, and of a delicate fibrous structure. It is soluble in water and

The analyses gave:

Protoxide of Iron..........	16.570
Alumina.................	9.131
Sulphuric Acid............	39.715
Water....................	35.097
Silica.....................	Traces
Magnesia.................	do
Lime......................	do
	100.513

This analysis, while not agreeing exactly with any given in Dana's mineralogy, would apparently place the mineral in the Halotrichite group.

The following table shews the composition of a number of specimens of Halotrichite compared with that of the mineral under consideration.

Locality.	Sulphuric Acid.	Alumina.	Ferrous. Oxide.	Water.
Moorfield....	36.03	10.91	9.37	42.03
Hurlet.....	35.60	7.12	13.56	43.71
"	30.90	5.20	20,70	43.20
"	28.63	2.85	19.35	48.58
Freyenwalde	43.90	15.25	7.50	33.10
Glace Bay...	39.71	9.13	16.57	35.09

It would be interesting to know how much time was occupied in the formation of this mineral at the Glace Bay Mines, some of the fibres being one-third of an inch in length. It can, however, only be remarked that the gallery in which it occurred had been excavated about twelve years ago.

Another hydrous sulphate, found as a product of decomposition in Coal Mines, is known as Alunogen.

The following analysis of a specimen occurring as an efflorescence at the Scotia Mine in Cumberland County, is taken from the report of the Canadian Geological Survey for the year 1878-79.

Sulphuric Acid...........	36·935
Alumina..................	13.479
Ferric Oxide.............	2.888
Ferrous Oxide............	.157
Water....................	45.109
Lime.....................	.140
Magnesia.................	.138
Potash...................	.087
Sulphur..................	.131
Insoluble................	.235
	99.299

Some years ago a hydrous sulphate of Alumina and Magnesia of similar origin was found on Silurian Slates at Newport, and was shown by the late Professor How to be identical with Pickeringite, a mineral up to that time known only in Peru.

Melanterite, the first of the minerals mentioned in this paper, belongs to the Copperas group, which contains among its more noteworthy species, the hydrous sulphates of Iron, Zinc, and Copper. The first named occurs in nature as a product of the decomposition of iron pyrites, and is largely made from the waste oil of vitriol from wire and galvanising works, with scrap iron, and from alum shale. The production of Copperas in the United States in the year 1882 was estimated at 15,000,000 pounds, valued at three quarters of a cent per pound. It is largely used by tanners and dyers on account of its forming a black colour with tannic acid. It is also used in paper mills, bleacheries, paint and ink manufactories, and as a disinfectant.

White Vitriol is a similar compound, formed naturally from the oxidation of Zinc Sulphide, and commercially by the action of Sulphuric acid on Zinc. As met in the Arts, White Vitriol is a form made by melting the Crystallised Sulphate and agitating it until it cools in a granular state.

Blue or Copper Vitriol is used in many dyeing and other chemical operations. When it occurs in nature in solution, as in the water flowing from copper lodes, large quantities of the metal are obtained by exposing it to the action of iron, when it is precipitated as a red mud, easily smelted and refined.

The minerals Feather-Alum and Pickeringite mark further steps in this chemical action of air and moisture on Sulphur. They may, broadly speaking, be considered as belonging to the native Alum group, the members of which contain water and sulphate of Alumina and some other sulphate. In Potash Alum, the common Alum of the shops, this other sulphate is a sulphate of potash. The corresponding sulphate in the other Alums is that of Soda, Magnesia, Ammonium, Iron or Manganese, and finally we have Alunogen, already referred to, a simple hydrous sulphate of Alumina.

We have already remarked on the formation of Sulphate of Iron by the oxidation of iron pyrites. When this action takes place in the presence of clays, largely composed of Silicate of Alumina, part of the Sulphuric Acid unites with the Alumina, and the commonest resulting form is that of a hydrous sulphate of Iron and Alumina, such as the mineral forming the subject of this paper. As the alkalies are frequently present in appreciable quantities in clays, true Potash or Soda Alums are often formed.

When clay slates are impregnated with these sulphates they are termed Aluminous, and are sometimes rich enough to yield Alum on the commercial scale. The following outline of the process is from Dana's Mineralogy, p. 128. The rock is first slowly heated, after piling it in heaps, in order to decompose fully the pyrites, and transfer the Sulphuric Acid of any Sulphate of Iron to the Alumina, and thus produce the largest amount possible of Sulphate of Alumina. It is next lixiviated in stone cisterns. The lye containing this sulphate is afterwards concentrated by evaporation, and then the requisite proportion of Potash (sulphate or chloride, alum containing potash as well as alumina) is added to the liquid. A precipitate of Alum falls which is afterwards washed and crystalised. In France Ammoniacal Salts are used instead of Potash, and an Ammoniacal Alum is formed.

At Whitby, in Yorkshire, the business of Alum making is a very old one, having been commenced by Sir Thomas Challoner in 1460, who brought workmen from France where the process had long been kept secret as a privilege of the ecclesiastical powers. The Alum shale occurs in strata of Liassic age, and is overlaid by a hard compact stone, known locally as "dogger." The Shale bed is about 200 feet thick, and is a hard bluish gray shaly clay which rapidly crumbles on exposure. The whole deposit abounds in iron pyrites, but only the richer portions are excavated for treatment. About 65 tons of the Shale yield a ton of Alum. It would unduly extend the limits of this paper to give the full details of the manufacture, which is based on that already outlined.

In the United States there are no deposits of Alum Shale of any commercial value, but the salt is manufactured to the extent of 20,000 tons annually, valued at about $800,000. It is nearly all made from alum clays imported from France and England. The process of manufacture is very simple and consists in mixing the Alum Shale with Sulphuric Acid, dissolving out the resulting

Sulphate of Alumina, adding an Alkali Sulphate and crystallising the resulting salt.

Domestic records show that through long ages the natural supplies of Copperas and Alum equalled the demands of the dyer and manufacturer. When this source was no longer adequate the chemist showed how the slow operations of nature could be hastened, and now these useful chemicals are produced with readiness, and at a price formerly deemed unattainable.

These minerals, however, are highly interesting from a different stand-point. Hitherto we have regarded them as the source of agents which have become indispensable to our comfort, and literally the foundation of many of the varied hues that man affects in his dress. But the study of their origin and natural transmutations give an instructive insight into some of the changes that are continually going on in the earth. We see them marking several of the alterations which have led to the disintegration of rocks, the formation of soils, of economic ores, etc.

In conclusion I may mention that the manufacture of these commercial Salts has not been undertaken in Canada. The total value of textile fabrics, which may call for various processes of dyeing, manufactured in the Dominion, was according to the last census nearly $20,000,000.

There would therefore appear to be a field for the manufacture of these Copperas and Alum Salts, in this country, and some of the shales of our coal fields may be found well adapted for the purpose.

ART. IV.—ON THE CANADIAN SPECIES OF THE GENUS MELILOTUS.—BY PROF. GEORGE LAWSON, PH. D., LL. D., F. R. S. C., F. C. I., &c.

(*Read March* 9, 1885.)

THE object of the following notes is to invite the attention of observers to the distribution of the species and varieties of *Melilotus* throughout Canada, so as to clear up some confusion that has arisen from imperfect observation, or mistake in nomenclature.

The *Meliloti* are old world plants, belonging originally to Europe, North Africa, and Asia; but we have in Canada at least two well-established species, and one of them, there is reason to believe, has been strengthening its hold ever since the days of the old French settlements at Quebec and in Acadia. In Europe, where these plants are more numerous in species and more abundant in quantity than with us, they are usually found growing on loose sandy soils; on railway embankments; rubbish-heaps; river and sea-shore banks; where, from land-slides or gradual denudation, a close turf is prevented from forming, and, generally, where the surface soil has been denuded of its original vegetation and left loose enough for the growth of annual or biennial plants. They are especially prone to appear on ballast heaps. From the great centres of old world civilization they have spread as colonists over North and South America, to Bermuda, and to other parts of the world far distant from their original homes.

The plants described by Tournefort under the generic name *Melilotus* were included by Linnæus in his genus *Trifolium*, which he divided into five sections. The first section consisted of the *Meliloti*, and, in the Species Plantarum, the capital letter M. for Melilotus is repeated on the margin before the trivial name of each species, thus:

TRIFOLIUM.

M. officinalis.
M. Indica.
Etc.

I do not know that any reason has been assigned for, or explanation attempted, of this apparent departure by Linnæus from his binominal rule. He may have intended merely to emphasize the section as a particularly well-marked one, or, perhaps, was unwilling to discard a long established and appropriate term. Whether the name *Melilotus* was intended to be used as a part of the trivial name, as indicated by Smith's mode of citing it—(given below)—or as a sub-generic term, which we may fancy is intended to be indicated by those who write " *T. officinale*, Linn," does not clearly appear. It is possible that Linnæus regarded this section of *Trifolium* as really entitled to generic distinction, and, anticipating its future elevation to the status of a genus, took this means of presenting to his followers the eminently appropriate name ready for use so soon as the distinctions and limits of the group should be fully ascertained. However it may be explained, this exceptional style of nomenclature created after confusion in the citations made by botanists from the Species Plantarum, as may be seen by the following instances, in some of which the generic name *Melilotus* is entirely ignored, and in others that of *Trifolium* :—

" *Trifolium Melilotus-officinalis*, Linn." — Smith's English Flora.

" *T. mel. officinalis*, Sp. Pl."—Lightfoot's Flora Scotica.

" *T. Melilotus officinalis*, L."—Koch's Synopsis Floræ Germanicæ. Loudon's Hortus Britannicus.

" *T. Melilotus*, L."—Hooker's British Flora, 5th edition.

" *T. officinale*, Linn."—Aiton's Hortus Kewensis, 2nd ed. Wight & Arnott's Prodromus. Hooker's Brit. Flora, 5th ed. Watson's Bibliographical Index of N. American Plants.

" *M. officinalis*, Linn."—Torrey & Gray's Flora of North America. Hooker & Walker-Arnott's British Flora, 6th edition. Hooker's Student's Flora, 1st edition.

The *Trifolium Melilotus officinalis* of Linnæus's Species Plantarum included three well defined forms that are now regarded by botanists as well-established species, viz:

1. The type, or normal form, which appears to have been long known in France and other parts of Southern Europe, although a comparatively recent addition to the British Flora, having been found in England for the first time about the year 1849 or 1850, and shortly afterwards in Scotland. It has been known to English botanists hitherto, mostly, as *M. arvensis*, Wallroth, but now appears in Sir Joseph Hooker's Student's Flora (edition of 1884) as M. OFFICINALIS *Desrousseaux*, although *not* the *officinalis* of Willdenow, so commonly quoted by authors.

2. Linnæus's variety *b*, variously named by authors *Trifolium Germanicum*, Smith; *M. vulgaris*, Willdenow; *M. leucantha*, Koch; M. ALBA, Desrousseaux.

3. The variety *g*, which has been recorded as a native and not rare British plant ever since the time of Ray, and which was known during the latter part of last and early part of the present century as *Trifolium officinale*, Hull, subsequently as *Melilotus officinalis*, Willdenow, and is now recognized as M. ALTISSIMA, Thuillier.

Of the above mentioned three species, two have hitherto been credited to Canada, viz: *M. alba*, Desr., and *M. altissima*, Thuillier. Respecting *M. alba* there is no question. It is a well known plant. It appears to be doubtful, however, whether *M. altissima* is established as a Canadian species, although it is so very common in Britain. All the Canadian yellow-flowered specimens of *Melilotus* that have reached me, so far, belong to *M. officinalis*, Desr., not *M. officinalis* Willd. Whether the United States plant is *M. altissima* or *M. officinalis*, I have not ascertained. Possibly we may have both species on this continent, but the only certainty in the matter is that we do not as yet know the distribution of either.

1. MELILOTUS OFFICINALIS, *Desrousseaux*.

This species, although, like the others, variable in size, habit and duration, being sometimes an annual, but usually a biennial, may be readily distinguished from its congener, *M. altissima,* by its cylindrical, plump, shining, bright-colored, transversely wrinkled, *glabrous* pod; in the flower, the wings and standard are about equal in length, longer than the keel. We still need more careful observation as to how far these differences in the comparative lengths of the vexillum, alæ and carina are constant in the several species of *Melilotus;* these differences were first specially noted in Dr. Hayne's communication, dated Schnobeck, 9th October, 1807, to Schrader's Neues Journal fur die Botanik. Although the flowers of *M. officinalis,* Desr., are constantly yellow in Britain and America, there is a white-flowered European form, named *T. Petitpierreanum,* for "Herr Petitpierre, General de la Grande Armée;" *T. Kochianum,* for "Herr Chirurgus Koch, in Gnadau."—*(See Hayne's letter.)*

This plant grows abundantly on the banks of the Avon River, near Windsor, Nova Scotia, where it has been long established, and presents every prospect of permanence; it is also general on the citadel, and in several other localities around the City, of Quebec, appearing as much at home as any of the original native plants. During the visit of the British Association to Montreal in 1884, I found it growing wild in the streets of that City, and Mr. P. Jack obtained it on the Montreal Mountain.

It is not improbable that the Canadian localities hitherto assigned to *M. altissima,* Thuillier, or some of them, may prove, on examination, to belong to this species. Indeed, I think it very probable that the localities given by Sir William Hooker in the Flora Boreali-Americana, viz: "About Montreal and Quebec. Lady Dalhousie, Mrs. Percival," belong to this species.

In Prof. Macoun's Catalogue, I, p. 107, *M. altissima, (M. officinalis, Willd.),* is said to be "naturalized at Pictou and Halifax, N. S." So far as I know, we have no established *Melilotus* in the Halifax district; but *M. officinalis,* Desr. (not *altissima)* appeared spontaneously one season in a sowing of *M. alba,* in the garden of Mr. P. Jack, Bellahill. As regards Pictou, Mr. A. H. MacKay, M. A., Principal of the Pictou Academy, has kindly taken the trouble to collect specimens for me on the ballast hills there, where he says the *Melilotus* is of comparatively recent introduction, and they all prove to belong to *M. officinalis*, Desr. That species may thus be regarded as an established plant at Windsor, Nova Scotia, Quebec and Montreal, and as "casual" or imperfectly naturalized at Pictou. At all of the stations where it is now permanently naturalized, it probably owed its origin to the early French settlers. It is the species described in Vaillant's Flora Parisiensis, and other French Floras of last century, and seems to have followed the movements of the French people. As regards the plants reported from New Brunswick, Ottawa, Belleville, Toronto, and London, Ont., they may or may not be referable here.

Melilotus officinalis. Desrousseaux, in Lamarck's Dict. IV., p. 63 (Koch), (1796,) Desfontaines, Flora Atlantica, II., p. 191, (Koch). Lois, Flora Gallica, ed. 2, II., p. 128, excl. syn. Willd., (Koch). Koch, Synopsis Floræ Germanicæ ed. 2, I, p, 183 (1843). Hook. fil., Stud. Fl. Brit. Isl., ed. 3, p. 96 (1884).

Melilotus officinarum Germaniæ. C. Bauhin Pinax, p. 331. Vaillant, Flora Parisiensis, p. 124.

Trifolium Melilotus officinalis (a). Linn. Species Plantarum, p. 1078.

T. vulgare. Hayne, in Schrader's Neues Journal fur de Botanik, II., p. 336 (1807).

Melilotus diffusa. Koch, in DeCand. Flore Francaise, V., p. 664, excl. syn. *a* DeCand. (Koch).

M. arvensis. Wallroth, Sched., 892 (Koch). Babington, Manual Brit. Bot., ed. 3, p. 72 (1851). Hooker & Walker-Arnott, Brit. Flora, ed, 6, p. 99 (1850). Hook. fil., Student's Flora Brit. Isl., ed. 1, p. 90 (1870).

Melilotus officinalis var. *floribus albis.* Koch, Synops. Fl. Ger., ed. 2, I., p. 183.

Trifolium Petitpierreanum. Hayne, in Schrader's Neues Journ. fur de Botanik, II., p. 337 (1807).

Melilotus Petitpierreana. Willdenow, Enumer., p. 790. Reichenbach, Fl. Exc., p. 498 (Koch). Koch, Synop. Fl. Ger., ed. 1, p. 167.

2. Melilotus alba, *Desrousseaux.*

This is a well known plant, often cultivated for bees, and it has attracted attention at different times as a source of fibre and paper pulp. In rich favourable soils it grows to a great size, rising to a height of from 6 to 10 feet, or even more. It is much branched, has clean and glabrous stems and foliage, and long dense racemes of numerous small white flowers. The wing and keel petals are shorter than the standard.

This species grows in great luxuriance about the Grand Trunk Railway yards at Toronto, and probably in other parts of Ontario; also about Montreal. It is specially a Railway Plant, but its range in Canada has not been traced. Being frequently cultivated, it is apt to occur as a "casual," and, in giving localities for it, observers should state explicitly whether the plant has taken permanent hold. In Halifax County it has been cultivated in gardens for many years, but does not spread.

Melilotus alba. Desrousseaux, in Lamarck's Encyclopedie Methodique, Botanique, IV., p. 63, (DC.) (1796). Reichenbach, Fl., Exc., p. 499. Koch, Synops. Fl. Germanicæ, ed. 2, I., p. 183. Eat. & Wr. 317. Gray, Manual, Bot. Northern N. S., p. 128. Brewer & Watson, Bot. California, I., p. 132. Hook, fil., Students' Flora, Br. Isl., ed. 1, p. 90. Watson, Bibliographical Index N. Am. Plants. I. p. 243. Macoun, Cat. Canad. Plants, I., p. 106 (1883).

Melilotus officinarum Germanicæ, flore albo. C. Bauhin Pinax, p. 331. Tournefort, Inst. Rei Herbariæ, p. 407.

Trifolium Melilotus officinalis, (b.) Linnæus, Species Plantarium, p. 1078.

Trifolium album. Lois. Flora Gallica, p. 479.

T. Germanicum, Smith, in Rees's Cyclopædia, XXXVI. (1819).

Melilotus officinalis (b.) alba. Persoon, Synopsis, I., p. 348 (1807). Nuttall, Genera, II., p. 104.

M. officinalis (b). Aiton fil., Hort. Kewensis, ed. 2, IV., p. 380 (1812).

M. vulgaris. Willdenow, Enumeratio Plantarum Horti Berolinensis, p. 790 (Koch), (1809). Spreng. Syst., III., p. 206, (Koch). Koch. Synops. Fl. Germ., ed. 1, p. 166. Babington, Manual Brit. Bot., ed. 3, p. 72 (1851). Hook. & Walker-Arnott, Brit., Fl., ed. 6, p. 98 (1850).

M. leucantha. Koch, in DeCandolle's Flore Francaise, V., p. 564 (1815). Seringe, in DeCand. Prodromus, II., p. 187 (1825.) Wight, Cat. Ind. Plants, No. 867. Wight & Walker-Arnott, Prod. Floræ Penins. Indiæ Orient., p. 196 (excl. syn. *altissima,* Thuill). (1834.) Beck, Bot., p. 78. Torrey & Gray, Fl., N. Am., I., p. 321. Torrey, Fl., New York, I., p. 171. Gray, Man. Bot., N. U. States, ed. 1, p. 108. Hook, Brit. Flora, ed. 5, p. 78 (1842). English Botany Supplement, t. 2689.

3. Melilotus altissima, *Thuillier.*

This species is readily distinguished by its dull colored, somewhat flattened, pods, which are *distinctly pubescent or scabrous;* the standard, wings, and keel of the flower are equal in length.

Many of the numerous localities given for this species in Canada and the United States probably belong to *M. officinalis,* Desr. I have not, so far, seen a Canadian specimen of *M. altissima.*

Melilotus altissima.— Thuillier, Flore des environs de Paris, ed 2, p. 378 and 83. (1799.) Loiseleur-Deslongchamps, Flora Gallica, II, p. 4. (1807.) (Seringe.) Seringe, in De Candolle's Prodromus, II., p. 187. Hook. fil., Student's Flora of Brit. Isl., 3 ed., p. 96, (1884).

Trifolium odoratum sive Melilotus vulgaris flore luteo. J. Bauhin. Raii Synopsis Methodica Stirpium Britannicarum, ed. 2, p. 195, (1696).

Trifolium Melilotus officinalis (g.) Linnæus, Species Plantarium, II., p. 1078. Willdenow, Sp. Plant, II., p, 1355. Sturm, Deutsch. Fl., fasc. 1, p. 15. (Seringe.) Hudson, Flora Anglica, ed, 2, p. 322 (1798). Withering, Arrangement of Brit. Plants, III., p. 645 (1796). Linn, Syst. Veget., ed. Litchfield, p. 561 (1783).

Trifolium officinale.—Hull, British Flora, p. 162 (1799); ed. 2, I., p. 216 (1808). Smith, Flora Britannica, p. 781 (1800.) Willdenow, Species Plantarum, III., p. 1355 (1801.) Hooker, Flora Scotica, p. 269. Smith, English Flora, III., p. 297. Aiton fil., Hortus Kewensis, ed. 2, IV., p. 380 (1812.) The following is doubtful:—Bigelow, Fl. Boston, p. 169.

Trifolium Melilotus altissimum.—Gmelin, II., p. 219 (Koch.)

Trifolium altissimum.—Lois, Flora Gallica, II., p. 4 (DC., Koch.)

Melilotus officinalis. Willdenow, Enumeratio Hort. Berol., II., pp. 789-90 (Seringe, Koch). Œder, Flora Danica, t. 934 (Seringe). Seringe in DeCandolle's Prodromus, II., p. 186 (1825). Koch, Synopsis Floræ Germanicæ et Helveticæ, ed. 1 p. 166. Hooker, British Flora, ed. 5, p 78 (1842). Hooker & Walker-Arnott, Brit. Fl., p. 98 (1850). Babington, Manual of British Botany, ed. 3, p. 72 (1851). Hook. fil., Student's Flora British Islands, ed. 1, p. 90 (1870). The following are more or less doubtful: Elliott, II., p. 199. Torrey, Flora of New York, I., p. 170. Torrey & Gray, Flora N. America, I., p. 320 (1838-40). Chapman, Fl. Southern N. S., p. 90. Gray, Manual, p. 128. Brewer & Watson, Bot. California. I., p. 132. Macoun, Catalogue, 1878, p. 11, No. 409. Jones, Transactions Nova Scotia Inst. Nat. Sc. Watson, Bibl. Index. Hemsley, Bot. Bermudas, Challenger Report, Botany, vol. 1. p. 28.

M. macrorhiza. Persoon, Synopsis, II. p. 348. Seringe in DeCandolle's Prodromus, II., p, 187 (Koch).

3. Melilotus Indica, *Allioni.*

This is a small, procumbent or ascending, rarely erect, plant, with branches spreading from the base. The racemes are short, of very small, almost sessile, crowded flowers, and elongate in fruit; pods globose-ovate, wrinkled.

This species occurs chiefly in the warmer parts of the south of Europe and in India. There are specimens from Brazil in the Edinburgh University Herbarium. In North America it had been found, when Torrey and Gray's Flora was published, only at New Orleans, as a recent introduction. It has since appeared in California. It was collected by myself on Wandsworth Common, near London, in 1851, and, subsequently, elsewhere in England by other botanists, but it does not appear to have become permanently naturalized as an English plant. Neither does it seem to have spread in the Atlantic States, nor to have reached Canada.

Indica appears to have been the first specific name, coupled with the generic term *Melilotus*, applied to this plant, for the publications of Allioni, who gave it, extended (so far as can be ascertained,) only from 1755 to 1789; but I have at present no means of reference to Allioni's works, published at Turin and Paris. Desfontaines' name, *parviflora*, under which this plant has more generally passed, was not published till the year 1799. The *Trifolium parviflorum* of Ehrhart is a totally different plant, a true *Trifolium*, the *T. strictum*, of Linnæus.—See Schrader's N. Journal, II., p. 112 (1808.)

Melilotus Indica. Allioni. Bentham in Mart. Fl. Bras. Smith in Rees' Cyclopædia.

Trifolium Melilotus Indica d. Linn. Species Plantarum, p. 1077. Roxburgh, Fl. Indica, III., p. 388; in E. I. C. Museum, tab. 411.

M. parviflora. Desfontaine, Fl. Atl., II., p. 192. Seringe in DeCandolle's Prodromus, II., p. 187. Hook., Comp., Bot. Mag. I., p. 22. Lawson, Proc. Bot. Soc. Edin., 1851. Torr & Gray, Fl. N. Am., I., p. 321. Gray, Pl., Fendl., p. 33, Pl. Wright, II., p. 41. Brewer & Watson, Bot., Calif., I., p. 132. Wallich, List of E. Ind. Plants, No. 5943. Wight & Arnott, Prod. Fl., Pen. Ind. Orient., p. 196. Hemsley, in Botany of Bermuda, Challenger Report, Bot., I. p. 29 (1885).

M. occidentalis. Nuttall in Torr. & Gr. Fl. N. Am., I. p. 321.

M. minima. Roth, Novæ Species præsertim Indiæ Orientalis, p. 361. De Candolle, Prod., II., p. 189. Sprengel, Syst. Veg., III., p. 208.

The following is a List of the Species and Varieties of *Melilotus*, as described in 1825 by Seringe, the monographer of this genus in De Candolle's Prodromus, Part II., pp. 186-189. It will show the distribution of the several species as known at that time, before railroads and ocean steamships had influenced their spread over the world. A few additional species have been subsequently described in the Annales des Sciences Naturelles, and other works, and modifications and corrections have been made in the nomenclature, in several instances; but I have limited the list, and retained the names strictly as given in the Prodromus:

Section 1. *Cœlorutis*:

1. *M. Kochiana.* Willd. Enumeratio Plantarum. Hort. Bot. Berolinensis, p. 790. (1809.) Germany and France.

2. *M. dentata.* Ibid. Hungary.

   Var. *b. angustfolia.* Wallroth, Schedulæ Criticæ Fl. Halens., I., p. 394. (1822).

3. *M. linearis.* Cavanilles (ex Persoon, Synops., II. p. 348, 1807). Spain.

4. M. *Ruthenica.* Bieberstein, Flora Taurica-Caucasica, p. 506, in note. (1808.) Sarepta, Syria.

5. *M. melanosperma.* Besser MS. (1824) in De Cand. Prod. (1825). Crimea.

6. *M. officinalis.* Willd. Enum., p. 790. (1809.) Europe.

   Var. *b. unguiculata.* Seringe in DC. Prod. II., p. 187 (1825). Berne and Geneva.

7. *M. palustris.* Kitabel MS. (1815) in DC. Prod., II., p. 187 (1825). Hungary.

8. ? *M. arborea.* Castagne MS. in DC. Prod., II., p. 187 (1825). Cultivated around Constantinople.

9. *M. altissima.* Thuillier, Flore des environs de Paris, ed. 2, pp. 378 and 83. (1799). Paris.

10. *M. leucantha.* Koch, in DeCandolle's Flore Francaise, ed. 3, V., p. 564. (1815.) Europe.

   b. unginculata. Seringe in DC. Prod., Pars II., p. 187. (1825.) Around Berne.

11. *M. macrorhiza.* Persoon, Synopsis, II., p. 348. (1807). Hungary.

12. *M. parviflora.* Desfontaines, Flora Atlantica, II., p. 192. (1799.) Barbary, Italy, France.

13. ? *M. segetalis.* Seringe, in DeCandolle's Prodromus, Pars II., p. 187. (1825.) Estremadura, Spain.

14. *M. Polonica.* Persoon, Synopsis, II., p. 348. (1807.) p. 188. Poland.

15. *M. Taurica.* Seringe in DeCand. Prod., II., p. 188. (1825.) Crimea.

16. *M. Italica.* Lamarck, Encyclopedie Methodique, Botanique, IV., p. 65. (1796.) Italy.

17. *M. gracilis.* DeCandolle, Fl. Française, V., p. 565. (1815.) Southern parts of France.

18. *M. pallida.*—Besser MS. (1824,) in DeCand. Prod., II., p. 188. (1825.) Volhynia, West Russia.

19. ? *M. suaveolens.* Ledebour, Enumeratio Plantarum Hort. Bot. Dorpatensis, Supplement, 1824, p. 5. Near Nertschinsk, Dahuria.

Section 2, *Plagiorutis.*

20. *M. arvensis.* Wallroth. Sched. Crit., p. 391. (1822.) Germany.

Var. *b. albiflora.* Wallroth, l. c., p. 392.

21. *M. elegans.* Salzmann MS. in DeCand. Prod., II., p. 188. (1825.) Corsica.

22. *M. Besseriana.* Seringe MS. in DeCand. Prod., II., p. 188. (1825.) Crimea?

Section 3. *Campylorutis.*

23. *M. Messanensis.* Desfontaines, Fl., Atl., II., p. 193. (1799.) Barbary, Sicily, Piedmont, Straits of Messina. Said to be the Lotos of the Greeks; Lotus of the Romans, Virgil Georgics, B. I., 84 B. III., 394.

24. *M. sulcata.* Desfontaines, l. c. (1799.) Algiers. Alexandria.

Var. *b. Libanotica.* Seringe, in DC Prod., II., p. 189. (1825.) Mount Lebanon.

SPECIES IMPERFECTLY KNOWN.

25. *M. Baumetti.* Hornemann, Hortus Reg. Bot. Hafniensis Supp., p. 84. (1819.) Native country unknown.

26. *M. minima.* Roth, Novæ Species Plantarum, p. 361. India.

27. *M. Neapolitana.* Tenore, Prod. Supp., I., p. 66. Catalogue, 1819, p. 57. Near Naples.

ART. V.—LOUISBURG—PAST AND PRESENT. A HISTORICO-GEOLOGICAL SKETCH.—REV. D. HONEYMAN, D. C. L., F. R. S. C., &c.

(*Read April 13th*, 1885.)

LOUISBURG is situate on the south-east side of the Island of Cape Breton, in lat. 45° 55°, and in long. 59° to 60.° It lies thus in the meridian of Standard time of Nova Scotia and the 16 hour meridian of Cosmic time. It is 3° 40° east of Halifax, and is the only place of notice in this meridian. It is first known in History as Havre a l'Anglois or English Harbour. It was so called as it was a place of resort for English Fishermen. This was its name previous to the year 1713. By the treaty of Utrecht, Cape Breton was ceded to France; it then received the name L'isle Royal. On its cession the French proceeded to fortify it, chiefly, by the erection of one Stronghold. The Port St. Anne, called also Port Dauphin and Havre a l'Anglois became rivals for this enviable distinction. La Ronde Denys says "Port Sainte Anne is without contradiction the finest Harbor in the world. It would cost only half the expense to make the fortifications there that it would at Port l'Anglois, as the materials are at hand. My deceased grandfather, Denys, had a fort there, the vestiges of which are yet to be seen."

Charbeois, says, "The sole inconvenience of the Port St. Anne, which every one admits to be one of the finest Harbours in the New World, is that it is not easy to make it. Havre a l'Anglois is considered to be of easy access and reputed to be generally free from ice. Another recommendation is, it opens direct into the Atlantic Ocean and consequently cannot be blocaded by an enemy." These considerations led to its selection as the future stronghold. Louis the Fourteenth was then King of France. After the "Grand Monarque" it was named Louisburg.

In 1714 Queen Anne died, and George the 1st, Elector of Hanover, succeeded to the Throne of Great Britain. In the following year Louis the Fourteenth died. His successor was his grandson, Louis the Fifteenth. As the latter was under age, Philip the Duke of Orleans became Regent. It was during his regency that the French were engaged in laying the foundation of the City and Fortress Louisburg, in the year 1718.

The first Governor of Cape Breton and Louisburg was M'de Costabelle, who was transferred from Placentia Bay, Newfoundland, when it was given up to Great Britain by the Treaty of Utrecht, With him were transferred the French inhabitants of Placentia Bay. These, with others from France, Canada and Acadia, formed the first population of Louisburg.

In the year 1723 the regent died, and Louis XV. assumed the reins of power, while only fourteen years of age.

In 1727 George I. died, and George II. succeeded him. At this time the Governor of Louisburg was M. de St. Ovide, who had been lieutenant du Roi under M. de Costelello.

In 1732, Louisburg was considered to be almost impregnable; about 30,000,000 livres, or 7,500,000 dollars, had been expended on its works. It had a strong citadel, and several other forts and batteries, well mounted with cannon.

In 1744, the garrison consisted of 600 regulars and 800 militia. At this time wars arose in Europe; thus, Maria Theresa, of Austria, had succeeded her father, the Emperor Charles VII., in 1740, but the Elector of Bavaria was made Emperor Charles VII., at Frankfort, in 1742, and claimed the Austrian possessions. The King of France took the part of the Elector, while George II. aided Maria Theresa. France and Great Britain were thus ranged on opposite sides. War was consequently declared by France against England, and England against France, in 1744. Duquesnel, who was then Governor of Louisburg, received intimation of the declaration of war two months before it was received in Boston, and immediately commenced hostilities. He sent M. de Vivier, with armed ships and 900 men, to Canseau, which was captured without opposition, and the inhabitants, who capitulated on certain conditions, were taken prisoners to Louisburg.

CITY AND FORTIFICATIONS OF LOUISBURG, IN 1745.

Looking at the chart before me, we are reminded somewhat of the City of Paris, inclosed within its fortifications. Our plan is from a survey made by Richard Gridley, lieutenant-colonel of the train of artillery at the siege in 1745. We could not well have better authority for our subsequent description. The scale is 300 feet to the inch.

The city and its fortifications occupied a tongue of land which formed the south-west side of the harbour. The suburbs seem to have been sparsely settled. The only settlements indicated in the map which accompanies the plan, are along the north-east side of the harbour. The city is divided into squares. Its streets run east and west and north and south. Of the former there are six in number, of the latter there are seven. The main street is No. 3 from the north. It extends from the Maurepas Gate on the east, to the Grand Parade, on the west. On this street is situate the hospital and the nunnery. The hospital on its north side is otherwise bounded by the second street on the north, and by the second and fourth cross streets, counting from the east the third cross street is intercepted by the hospital, and terminates on the main street. The nunnery on the south side of the main street is otherwise bounded by street No. 4 and No. 5. There is a square between this establishment and the grand parade. Other buildings named are the ordnance store and the general store. Attached to the former are the arsenal and bake house. Adjacent is the fortification stores. These occupy a grand square in the north-west corner of the city. There are three gates having names, viz., Maurepas Gate, already referred to, at the east end of Main Street. Queen's Gate at the south end of the second cross street, and Frederick's Gate on the north, opposite the seventh cross street leading to the harbour near the general store, and which is called the *Key Curtain* and the West Gate. The length of Main Street from the Maurepas Gate to the Grand Parade is 1500 feet. This is the greatest length of the city The street north of it is 1300 feet in length. This is shortened by the great pond which is on the north-east side of the city. It extends, however, farther west than the main street, as the latter is shortened by the Place of Arms of the citadel, which is on the west of the Grand Parade. The 4th cross street has a length of 1300 feet, The fifth street is 1200 feet long. These two represent the greatest breadth of the city. Length of the city 1300 to 1500. Breadth 1200 to 1300.

FORTIFICATIONS.

On the east side of the City, we have on either side of the Maurepas Gate, guard houses, then the Talus or slope of the Rampart and Rampart, then a broad ditch crossed by a bridge 150 feet in length. On the left (N) of this is the Maurepas Bastion, and on the right (S.) the Brouillan Bastion. In front of the Ditch and Bastions is the intermediate angular place of arms with Traverse on either side, Ramparts and Glacis with entrance.

The south-west side has its fortifications. The chief is the Citadel or King's Bastion. I have already said that this is situate on the west end of Main Street and the west side of the Grand Parade. This is an exceedingly strong fortification. It has a spacious Place of Arms and Glacis towards the Grand Parade. There is a Guard House near the entrance to the City. There are then two Covert-ways with two Traverses, between these is the entrance to the Citadel. The entrance crosses a ditch which is about 50 feet wide. In the inside we have (1st) the Chapel next the entrance. In a line with this, occupying the south-east corner, are (2nd) the Governor's Apartments. In a similar position on the north-west corner are (3rd) the Barracks. The sides adjoining 3rd and 2nd have Casements. Beside the Barracks is the Parade. The four sides are bounded by the broad ditch which extends along the whole series of fortifications, and hence in our description may be called the Great Ditch. Its length is about 3000 feet, and its breadth from 100 to 200 feet. On the other side of the Ditch is the Covert-way, and then the Glacis. Opposite (west) north corner is a Place of Arms with Glacis. Here there are neither Traverses nor outward passages. The distance from the foot of the Glacis of the Place of Arms on the east to that of Glacis of the Place of Arms on the west is 2900 feet. This running along the length of the City represents the extreme length of the City and Fortifications.

QUEEN'S BASTION

Is about 450 feet S. E. from the Citadel. Between the two extend a Rampart, a Parapet, the Ditch with a bridge, a Place of Arms with Covert-ways, two Traverses and a Glacis with passage.

PRINCESS' BASTION

Is about 450 feet from Queen's Bastion. Between this and the preceding is a Rampart, a Parapet, the Ditch with bridge, Place of Arms with covert-ways, and two Traverses, a Glacis and passage. At the north end of the bridge is the Queen's Gate and entrance to the City. In this Bastion is a fortified Cazemet. (I give the old spelling of words like the last.) This Bastion has its east side on the shore, north of Black Cape. At the back of the Bastion is a small pond. Between this Bastion and the Brouillan Bastion is a Small Arms Curtain which extends along the shore about 525 yards. Between this and the City is a Picquet Line raised during the siege in 1745.

DAUPHIN BASTION.

This is situate on the north-west of the Citadel at a distance of about 550 feet. Between, the ditch is about 200 feet wide. Between the two and at the Dauphin is a Pond. This is crossed by a bridge near the Bastion. Outside are Covert-way and Glacis. Inside of the Fort, beyond the Rampart, are a Powder Magazine and a Guard House. This Bastion is near the Harbour. In the inside and in the City is another Pond.

PROFILE OF THE FORTIFICATION.

West,—a. Glacis, b. Banquet, c. Covert Way, d. Counterscarp, e. Ditch, f. Parapet, g. Banquet, h. Rampart, i. Talus. *East*,— Back of the Dauphin Bastion is "The Spur." Attached to this is the west end of the *chain boom*, which extends to the east and opposite side. This *boom* was to protect the French ships in 1748.

THE KEY CURTAIN.

This extends from the *Spur* and runs sub-parallel with the shore as far as the Battery la Grave (*Greve*) to a length of about

1800 feet. In it there are 5 openings. The second from the Dauphin Bastion is Frederick's Gate, already referred to as a gate of the city.

BATTERY LA GRAVE.

This is the last of the city fortifications. It faces the N. E. The great pond already referred to is in the rear, and part of it forms a ditch on the east side of the battery. A bridge about 500 feet in length passing through the pond connects the battery with the Maurepas Bastion. The distance from the Battery la Grave (N. side) to the foot of the glacis, between the Queen's and Princess' Bastions (S. side), is 2350 feet. (less than half a mile). This is the greatest breadth of the fortification. The circuit of the fortification is about 10,250 feet, (less than 2 miles.)

BURYING GROUND.

This lies to the east of the city, between it and Rocheford Point.

ISLAND BATTERY

Is an Island opposite Rockford Point, in the north of the harbour, and next its entrance. This was formed of rocks about 600 feet long and 60 broad. This was an important part of the defences of Louisburg, as it was mounted, 30 guns, 28 pounders.

ROYAL BATTERY.

This stood on the north side of the harbour and opposite its entrance.

CAREENING PLACE

Is another point of interest indicated on our map. This lies on the east side of the harbour at a distance of about half a mile north-west from the light-house.

In Autumn 1744, the project of taking Louisburg originated in New England. The soldiers and inhabitants of Canso, who had been taken prisoners by Duvivier were at this time sent to Boston, according to the terms of capitulation. From what they had seen of the fortifications of Louisburg they considered that it could be taken, and advised accordingly. This and other considerations led to the carrying out the projected siege. Nine regiments were raised and equipped in 50 days, under the command of Sir Wm. Pepperill. A British Fleet under the command of Commodore Warren assisted. From Boston the Expedition proceeded to Canso.

On Sunday, April 29th (O. S.) they sailed from Canseau. On the 30th the British Fleet and transports anchored off "Flat Point," in Gabarus Bay, which lies to the S. W. of Louisbourg, "but the forces were prevented from landing by a detachment from the city." At Kennington Cave, in the same bay which was subsequently so named, the New England Forces landed before the detachment from Louisburg could come round to oppose them. The distance between this and Low Point is a mile and a half.

On May 2nd the settlements on the N. E. side of the harbour were destroyed by the besiegers; on which, the garrison in the "Royal Battery" immediately deserted it.

"On May 26th the English attempted to take the 'Island Battery' when 60 men were drowned and 116 taken prisoners."

"The English Battery, erected at the Light House on the N. E. side of the entrance to the harbour, on June 11, demolished the Island Battery."

"This important fortress was taken on the 17th of June, 1745, after a siege of 49 days and the loss of 100 men killed and 30 that died by sickness." These quotations are from notes on our plan and map.

CONTEMPORARY EVENT.

The battle of Fontenoy, Belgium, was fought the same year, (1745).

CELEBRATION OF VICTORY.

The news of the fall of Louisburg reached London on July 23. The event was celebrated with the customary demonstrations of joy. The firing of guns in the Tower and Park, the illumination of London, blazing bonfires, and the ringing of bells. Sir Wm. Pepperill was created a Baronet, and Commodore Warren was promoted Rear Admiral of the Blue.

A glorious reception was accorded to Sir Wm. Pepperill, Baronet, and the Hon. Admiral Warren when they reached Boston on the 25th June, 1746. The speaker and representatives also tendered their congratulations. In 1746 Louisburg had become the head military quarters of the British. The New Englanders, numbering about 1500, occupied the place from the time of its surrender. These were succeeded, in Autumn 1745, by two regiments of foot and three companies of another regiment.

In the same year a fleet was sent from France for the purpose of recapturing Louisburg, and also Nova Scotia. This was under the command of the Duc d' Anville. Contrary winds, storms and other casualties proved fatal to the fleet and its commander, and Louisburg remained undisturbed. We find, however, that the new proprietors were much discontented with the state of matters existing in these new acquisitions, and gave full scope to their complaints. Knowles, the Governor, sent such doleful representations to the Duke of Newcastle that the British authorities seem to have considered Cape Breton and Louisburg not desirable possessions, so that it is not surprising to find that "This place was afterwards restored to the French by the treaty of Aix la Chapelle." In 1748 the war between England and France, which began in the spring of 1744, came to an end, and Cape Breton again became a French possession by the treaty. The British Parliament voted indemnity to the colonists for expenses connected with the conquest of Louisburg. The sum voted amounted to £235,749, 2s. 10¼d. sterling. As the same treaty secured Nova Scotia for Great Britain, it was considered advisable to fortify Chebucto as a naval and military station. Cornwallis, who had been appointed Governor, strongly recommends this step in his despatch to the Duke of Bedford, the Secretary of State. Cornwallis sends one of the transports to Louisburg on the first of July and four others on the fourth, to transfer the English Troops from Louisburg to Chebucto. Col. Hopson, who had been the English Governor, delivers up the place to M. des Heblier, the French Commandant, embarks on the 12th with the two regiments under his command, and shortly after arrives at Chebucto.

Of the Governor Desheblier, Cornwallis bears the following testimony, "I am extremely sorry to hear that M. Desheblier goes back to France this summer. He has behaved with great honour and sincerity." (July 1750).

Desheblier's successor was the Count de Raymond, a man of a different spirit. We find him complaining to Cornwallis that the New England fishermen dried their codfish on the islands of Canceaux. He claims these islands as French territory. Cornwallis in reply complains of Frenchmen fishing at the isles of Canceaux, and even at Whitehead, both undoubtedly in the territory of the king of England. These letters were very courteous, still they express a difference of opinion which might cause antagonism of a different kind. In July 1750, Col. Pengrine Thomas Hopson, the Governor of Louisburg at the time of its cession to France, was appointed Governor of Nova Scotia, successor to Cornwallis, 1753. On the 1st of November, Hopson, the Governor of Nova Scotia, sailed for England, and Hon. Charles Laurence became administrator of the government. In 1755 Drucourt was commandant at Louisburg. In the month of March the schooner La Marguerite, Capt. Lesonne, was sent from Louisburg laden with provisions for the French port at the river St. John. Besides provisions she had cannon and ball. She was captured by H. M. Sloop of War, the Vulture, Capt. Kenzie, commander. Being brought into Halifax she was tried and condemned by the Vice-Admiralty Court. Governor Drucourt wrote to Governor Laurence asking explanations. In reply he was informed that the Captains of the English Navy have their instructions from the English Government, and are not under the orders of the Governor. That the vessel was condemned for contraband trading. The Assembly of Massachusetts now passed a law prohibiting all correspondence with the French at Louisburg.

These and similar proceedings were occurring while England and France were under treaty of peace, we are therefore in some measure prepared for the following. On the 18th of May, 1756, war was declared by England against France, and on the 9th of June, France declared war against England. (This was the beginning of the seven years war in Europe.) In the English declaration charges were made against the French of usurpations and encroachments upon the territory and settlements of British subjects in the West Indies and North America, and particularly in the province of Nova Scotia. Louisburg henceforth became the scene of conflict between the English and French. On the 9th of August war was publicly declared against France at Halifax. In April, Admiral Holborn who had sailed for America with a squadron consisting of 11 ships of the line, 50 transports with 6100 soldiers commanded by General Hopson, and Lord Loudon, with transports from New York, arrived at Halifax.

At Louisburg there was then 18 French Men of War under command of M. Dubois de la Monte. In the month of July information was received that there were in Louisburg 6000 regular troops, 3000 inhabitants and 1300 Indians with 15 men of war, three 84, six 74, eight 64, one 50, and 3 frigates. The English Fleet had 15 sail of the line, and one ship with 80 guns, and 3 frigates. The expedition resolved upon was abandoned. Twice Admiral Holborne proceeded to Louisburg and was detained from making an attack in consequence of the French superiority of force.

In 1758, M. Beaussier sailed from Brest for Louisburg with 5 men of war and 16 transports with 1270 soldiers and great quantities of provisions and ammunition. On Monday, 8th May, a fleet under the command of Hon. Edward Boscawen, Admiral of the Blue, arrived at Halifax from England, second in command was Sir Charles Hardy, Vice-Admiral of the White. The fleet consisted of many ships of war and transports. Amherst was to be Military-Chief. This armament was intended to besiege Louisburg. There were 23 ships of the line, 18 frigates and transports. The whole fleet numbered 157 vessels. The soldiers under General Amherst, with whom were Wolfe, Laurence and Whitmore, Brigadier Generals, were 11,936 foot, and 324 artillery.

Before the advance of this formidable armament we would in a manner *reconnoitre* Louisburg in order to ascertain if there are any works erected since, the siege of 1745, or any special preparations made to meet the enemy.

We observe "A new battery erected since 1748," that is after the definitive Treaty of Peace was signed at Aix la Chapelle.

This was probably erected when the British were engaged fortifying Halifax harbour.

The battery is on the point of the tongue of land on which Louisburg is built. Between it and the city is the burying ground and a "Lime Kiln." It is semicircular, commanding the harbour and its entrance as well as the outside, between the tongue of land and Black Cape. The latter lies between the latter and the former.

At Black Cape there is "A battery (c.) erected by the French to oppose the English landing."

At White Point, S. W. of Black Cape, and east of Gabarus Bay are "Lines B. B." erected for the same purpose.

At Flat Point, $1\frac{1}{4}$ miles (W.) in the bay where the "British fleet and the transports anchored in 1745" are also "Lines B. B." Here is Artillery Cove, or Fresh Water Cove, into which flows Fresh Water Brook. In the cove, farther west, (subsequently called Kennington Cove) "where the New England forces landed in 1745," are "Lines B. B. to oppose the English landing." In the harbour, north of the city, are anchored "French Ships," President, 74; Entreprenant, 74; Capricieux, 64; Celebre, 64; Bunfaisart, 64; Diana, 36; Echo, 26; Apollon, 50; Chevre, Biche and Fidele. In the mouth of the harbour the Island battery, and the English battery at the Light House. The land forces are 24 companies of Marines, 2 companies of Artillery, 2nd battalion Voluntaires Etrangers, 2nd battalion reg. de Canbere, 2nd battalion de Reg. d'Artois, 2nd battalion de Reg. de Bourgogne, 3000 soldiers and 700 cavaliers. By comparison it will be observed that now the British odds was overwhelming. On May 28th, Admiral Boscawen sailed for Halifax, fleet and troops. He was joined by General Amherst and General Bragg.

On June 2nd the fleet with about a third of the troops anchored in Gabarus Bay. They were then arranged as follows, off White Point: "The White Division, Detachments of the Right Wing. Brigadier General Whitmore; Colonels Burton and Foster; Majors Prevost and Darby. In front (right) the Squirrel, frigate; left, the ship Sutherland, 50 guns. About $\frac{1}{4}$ of a mile to the right, a detachment of the Right Wing."

Off Flat Point is the Blue Division, Detachments of the Left Wing, Brigadier General Laurence, Colonel Wilmot, Lieut. Col. Handfield; Majors Hamilton and Hussey. In front (centre) the Shannon, frigate; on the right Diana, frigate; on the left Gramment, frigate.

Off Kennington Cove is the Red Division, Grenadiers, Irregulars, Light Infantry, Highlanders. Brigadier General Wolfe; Colonels Fraser, Fletcher, Murray; Majors Murray, Scott, Farquhar. In front is the Kennington Frigate. On the left (front) between the troops and the land is the Halifax, snow. On the shore about ½ of a mile N. W. of the Kennington is "(A) the place where the English landed."

About sunrise the Kennington and Halifax, snow, began to fire, this was followed by the Gramment, Diana and Shannon in the centre, and the Sutherland and Squirrel on the right. After a quarter of an hour's firing the boats upon the left rowed into shore, commanded by General Wolfe. Lieuts. Brown and Hopkins and Ensign Grant, with about 100 light infantry, gained the shore over almost *impracticable rocks and steeps* to the right of the cove (A). General Wolfe directed the remainder of his command to push on shore. Light Infantry, Highlanders and Grenadiers rushed on intermixed. General Whitmore with his command made a feint of landing at White Point. General Laurence's division did the same at Fresh Water Cove. The enemy's attention was thus drawn to every part and prevented from concentrating at Kennington Cove. General Wolfe having landed at the left of the cove, attacked the enemy and forced them to retreat. As soon as this division was landed, the centre and the right division followed. The pursuit ended with a cannonading from the town. This seemed to indicate the range and position for encampment. In our chart we have "The encampment of British troops during the siege in 1758." It is in the form of the half of an ellipse. The south-west end is at Flat Point or Artillery Cove. The north-east is near a small brook that enters Barasoi and the harbour. Its extremities are distant two miles. The middle is nearly two miles distant from the city fortifications. Then we have Greenhill half a mile west of the city (X) with "The Epaulments." This was one-quarter of a mile long, 60 feet wide and 9 feet deep, consisting of gabions, fascines and earth (X). The plan of operation now, as suggested by Col. Bastide, engineer, was to make their approaches by Greenhill, to connect the camp with the light-house battery by a road, redoubts and block-house around the harbour, and to use the light-house battery for the destruction of the ships, and in silencing the island battery. The French destroyed their battery (C) at Cape Noir, and all the other buildings, and left nothing standing within two miles of the town walls but ruins. They also destroyed the light-house battery and spiked the four guns. Wolfe marched round with 1200 to the light-house, sent guns, etc., by water, and took possession of the ground and outpost which the French had abandoned. "The Epaulment" at Greenhill was made 60 feet wide, 9 feet deep, and five-eights of a mile long. Between Greenhill and the City we have the "First line of approach" at a distance of a quarter of a mile from the city. Still nearer is the "Second approach," extending to the harbour on the north, and a distance of about 200 yards from the Dauphin Bastion, and 330 yards from the Citadel. These works extend from the eastern extremity of the "Epaulment" and stretch the whole rear of the city—from the Dauphin to the Princess Bastion. On the 20th the island and ships began to fire at the batteries on shore. On the 25th the light-house battery had silenced the island battery. On the 29th the English were at work on the road between the encampment and the light-house battery. The French now sunk four vessels in the mouth of the harbour. 1st the Apollon, a two decker, whose position and name is seen on our charts; the Fidele, of 36 guns; La Chevre and La Biche, of 16 guns each—cutting off their masts. This reduced the number of their ships to 6, as the Echo had been captured previously by the Tuno and Scarbero, on her leaving the harbour for Quebec. July 1st, a French party were driven in by Wolfe and Scott's light infantry. 2nd, The French continued their canonade, and sent out parties to skirmish. 3rd, Their canonade was heavy. At this time Wolfe was making an advanced work on his right to bear on the Citadel Bastion (2nd approach). During the bombardment that succeeded "The barracks, government house and church were burnt. Each cannon shot from the English batteries shook and brought down immense pieces of the ruinous walls, so that on a short cannonade the Bastion du Roi, the Bastion Dauphin and the Courtin of communication were entirely demolished, all the defences ruined, all the cannons dismounted, all the parapets and banquets razed, and as there was one continued breach, an assault was possible everywhere."—*Description by a French Officer.* On the 26th July all the French batteries were in ruins, all their cannon disabled, all their men-of-war were captured or destroyed. The inhabitants petitioned M. Drucourt to surrender. Articles of capitulation were agreed upon, and Louisburg and Cape Breton a second time became a British possession.

ADMIRAL BOSCAWEN.

In the collection of medals of the Provincial Museum there is one of rude make, which commemorates the last siege of Louisburg. On one side is an effigy of Admiral Boscawen, and the inscription "Admiral Boscawen took Cape Breton." On the reverse is a representation of Louisburg and its bombardment with the fleet in the bay. Above is "Louisburg," and at the foot "July 26, 1758." The medal was found in New Jersey, 1875, and presented by Mr. Hamilton.

The plans of Louisburg, to which I have referred so often, were published by Thomas Jeffreys, Geographer to the Prince of Wales, at Charing Cross, Oct. 9th. 1758. Presented to the museum by the late Archbishop Hannan.

HISTORY CONTINUED.

In the year 1759 we find Admiral Saunders, with his squadron, off Louisburg, and unable to enter the harbour on account of the ice. On May 14 he again came to Louisburg and found the harbour open. This was in anticipation of the expedition to Quebec, Louisburg being a rendevous in common with Halifax. By the 26th of June we find Admiral Saunders and General Wolfe at the Isle of Orleans, a few leagues below Quebec. Whitmore was then Governor of Cap at Louisburg.

On Feb. 9th of the following year, 1760, (Secretary Pitt sent the King's orders) orders came from England to demolish and raze the fortifications of the town and harbour of Louisburg, and to transport garrison, artillery, stores, and useful building material to Halifax. Nine months after the fortifications were razed and blown up, the Key Curtain destroyed, every glacis levelled, and everything of use transported to Halifax. This was in the 46th year of the reign of George, second, and the 37 years of Louis XV. reign. Thus in the course of 57 years Louisburg rose, culminated, and set. It had a short but eventful history.

The close of the seven year's war and the peace of Paris occurred in 1763, *i. e.* three years after the destruction of Louisburg.

In September, 1861, I visited Louisburg, shortly after it had been visited by Prince Napoleon. The object of my visit was more for geological than historical investigation. Finding nothing of geological interest between Mira Coast and its Carboniferous (coal) Formation and Louisburg harbour, as all the rocks were obscured, I made my way to the shore at North Cape near the light-house. Here I saw stretching along the shore a magnificent expanse of Syenitic rocks, which I did not expect to find. They were of reddish color with broad green bands. I secured a specimen representing this interesting feature. At that time I regarded the rocks as of igneous origin and uncertain age. With Dr. McLeod and others I then visited the ruins of Louisburg, and examined them. The orders received for the demolition and razing of the fortifications were certainly faithfully executed, still there are interesting remains that seem to mark the place where the fortifications stood. Here are what is styled remains of the " Bomb proof vaults." There are three of them which were used as sheep pens, sheep taking shelter there and making an organic deposit. There are evidently portions of the casements which I have indicated from the plan as forming part of the King's Bastion or Citadel. After lingering as long as our time would permit we proceeded towards Gabarus Bay. I had seen molybdenite taken from the rocks of Gabarus, and it was reported that gold had been found in them. Gold had just been discovered in Nova Scotia. All were seeking for gold. It was according to reports turning up everywhere. On our way we had to traverse bogs and swamps, as the besiegers of Louisburg had to do. Reaching the shore I found rocks similar to those of Light-house Point. I presume that now we were south-west of Rock Point. These too were reddish syenitic rocks with broad green bands. Going along the shore to some distance we found these rocks extending onward. A beautiful view of Louisburg was painted by Forshaw Day, and exhibited at Exposition Universelle de Paris, 1867.

The admiralty charts give names to prominent Points—different from those of our old charts.

North Cape is Light House Point.
Black Cape " Black Rock Point.
White Point " unchanged.
Careening Place " Careening Point. (The Railway terminus).
Kennington Cove is unchanged.

The end of the tongue of land on which the city stood is called Rockford Point in charts dating 1780.

RELICS.

If Louisburg in its zenith somewhat resembled the City of Paris in aspect, its existing state forcibly realizes our conceptions of the modern aspect of certain renowned cities of antiquity, against which, as against the City of Tyre, the edict went forth, raze it, raze it, even "To the foundations thereof." The remains are now regarded as relics to be treasured up in museums. Of these we have a fair share, presented by various donors.

1. A large hinge with arms 3 feet in length, having wood attached with bolts. Presented by Hon. Robert Robertson, former Commissioner of Mines.

2. A Chain Plate off one of the ships sunk in the harbour. Presented by D. Cronan, Esq.

3. Piece of a Cannon, brought up from the harbour bottom.

4. A Bunch of Brass Keys. Presented by Bateman, Locksmith.

5. A Cannon Ball. Presented by Mr. McAlpin, Louisburg.

6. A Hand Grenade. Presented by Lieutenant-Governor Archibald.

7. A Gun Barrel.

8. A Bayonet.

9. Pieces of a Shell.

During the 24 years that have elapsed since my visit to Louisburg our views on the geology of Cape Breton as well as of Nova Scotia have undergone considerable change. The rocks on Louisburg shore, which I regarded as of igneous origin, are now regarded as metamorphic rocks, and instead of being considered as of comparatively recent age, *c. g.* Devonian or Upper Silurian, they are now regarded as having been formed in Precambrian or Archean time. I have compared them with the "Middle Arisaig Series" of the Cobequid Mountain, I. C. R. section.—*Trans. Institute of Nat. Science*, Vol. IV, page 475.

The formation of Mira Ridge which is associated with the Louisburg Crystalline rocks and lies between them and the Carboniferous, already referred to in a preceding page, are of Lower Silurian age, being approximately equivalent to the Upper Lingula Flags of Wales. In the upper part, next to the Carboniferous, Mr. Fletcher of the Geological Survey, found abundance of fragments of Trilobitez, of Genera *Olenus*, and *Agnostus*. In a position apparently lower, and next to the Crystalline rocks of Gabarus, the Rev. Donald Sutherland found Sandstones with numerous *Lingulellæ* and *Obolellæ.* (?) Mr. Bowser, of Halifax, collected at Scatarie specimens of beautiful Jaspideous Conglomerate and Breccias, which I have regarded as a part of the Louisburg series.—*Trans.*, vol. iv, pages 252 and 258. These are in our museum collection. The geological formations are therefore Archæan, Lower Silurian, and Carboniferous.

RAILWAYS.

Louisburg Harbour has again come into prominence in connection with the Railway development of the Dominion of Canada. This time it appears as a rival to Halifax

Harbour, not as a stronghold but as the terminus of the Intercolonial. Already it is the terminus of a Short Line, which has done good service in exposing geological formations, which were obscure at the time of my visit. This railway terminates in the harbour at "Careening Point." Here coal can be shipped while Sydney Harbour is ice-locked. This is one advantage gained. If its grand claims should come to be conceded and its expectations realized, Louisburg may again become a place of note, not as a fortified, but as a commercial city, and its latter glory may yet exceed its former.

ART. VI.—LIST OF PLANTS COLLECTED IN THE NEIGHBOURHOOD OF TRURO, NOVA SCOTIA, DURING THE SUMMERS OF 1883 AND 1884. BY GEORGE G. CAMPBELL, B. SC. COMMUNICATED BY DR. LAWSON.

(*Read April* 15, 1885.)

THE following List was prepared from collections made during the summers of 1883 and 1884.

With regard to the localities mentioned around Truro, it may be well to state, for the benefit of those who are not acquainted with the locality, that the places called respectively, "Smith's Island," and "McClure's Island," are not really islands in the proper acceptation of the term, but small tracts of land slightly elevated above the general level and surrounded by marsh or swamps. Probably the "islands" so called, at one time were really surrounded by water at high tide, and the marsh around them constituted "mud-flats" so called, at low water, but, as the land has been dyked, the marshes are now nearly dry, except in the spring, when they are covered with fresh water brought down the rivers and brooks by the freshets.

The particular dates given for plants collected during the months of April, May, and June, indicate not only the time of collecting specimens, but also the date at which the first open flowers were observed. For instance, the date given for Viola blanda, is May 5th, when I noticed a few flowers open on a sheltered spot facing the south, though the species could not be said to be fully in bloom before the middle of the month.

In the order Compositæ the Asters and Solidagoes are not included, the species not being yet determined. The Polygonaceæ Salicaceæ, and Cyperaceæ are very imperfect and will be included in a future list. The nomenclature is that of Gray's Manual, fifth edition, eighth issue.

RANUNCULACEÆ.

Clematis Virginiana, Linn. Banks of streams, among alders, etc., common.

Thalictrum Cornuti, Linn. Marshes, common, June 30th, 1884.

Ranunculus multifidus, Pursh. In water, in ditches, marshes, common, June 1883.

R. aquatilis, Linn., var *trichophyllus*, Chaix. Ditches in little marsh near Smith's Island, June 11th, 1884.

R. abortivus, Linn. Cultivated fields, common, May 26th, 1884.

R. repens, Linn. In fields, low grounds, etc, common, June 5th, 1884.

R. acris, Linn. Very abundant in grass, roadsides, etc, introduced June 9th, 1884.

Coptis trifolia, Salisb. In spruce woods, etc., common, May 25th, 1884.

Actæa spicata, Linn., var *rubra*, Michx. In hardwood at the Falls; also banks of ravine back of Terrace Hill Cemetery, June 9th, 1884.

NYMPHÆACEÆ.

Nymphæa odorata, Ait. In Lily pond, near Truro Cemetery.

Nuphar advena, Ait. Brooks and gullies in the marsh, common.

FUMARIACEÆA.

Corydalis glauca. Pursh. Newly cleared land near Terrace Cemetery, 1883.

CRUCIFERÆ,

Nasturtium officinale, R. Br. Brooks and ditches, common, June 8th, 1884.

Dentaria diphylla, Linn. In ravine back of Terrace Hill Cemetery, June 8th, 1884.

Brassica Sinapistrum, Boissier. Very abundant in grain fields. Introduced.

Capsella Bursa-pastoris, Moench. Waste places around dwellings. Introduced. June 1st, 1884.

VIOLACEÆ.

Viola blanda, Willd. Damp fields and swamps. Very common. May 5th, 1884.

V. cucullata, Ait. In grass fields, common, May 18th, 1884.

V. canina, Linn, var *sylvestris*, Regel. In woods at Smith's Island, May 28th, 1884.

HYPERICACEÆ.

Hypericum ellipiticum, Hook. On the borders of ditches in Truro marsh. August, 1884.

H. perforatum, Linn. In damp fields. Aug. 11th, 1884. Introduced.

H. mutilum, Linn. In wet woods back of Terrace Hill Cemetery. August 20th, 1884.

H. Canadense, Linn. Sandy spots in the marsh, common. August, 1884.

Elodes Virginica, Nutt. Common in swamps. Smith's Island, etc. August, 1884.

CARYOPHYLLACEÆ.

Arenaria lateriflora, Linn. Borders of woods, common. Smith's Island, the Falls, etc. June 18th, 1884.

Stellaria media, Smith. Common weed in gardens and damp places around dwellings. June 9th, 1884. Introduced.

S. Congifolia, Muhl. In grass. Marsh, common. June 18th, 1884.

Cerastium viscosum, Linn. In grass fields and pastures, common. June, 1884.

C. arvense, Linn. In grass fields and roadsides, Wimburn Hill, June 4th, 1884.

Spergula arvensis, Linn. In grain fields. Common. August, 1884.

GERANIACEÆ.

Impatiens fulva, Mitt. In swamps around Smith's Island.

Oxalis Acetosella, Linn. Damp woods at the Falls, also ravine back of Terrace Hill Cemetery, June 26th, 1884.

O. stricta, Linn, In cultivated grounds. Common. June, 1884.

SAPINDACEÆ.

Acer Pennsylvanicum, Linn. Ravine back of Terrace Hill Cemetery, the Falls, etc. Common. June 11th, 1884, in flower.

A. spicatum, Lam. Wooded banks at Bible Hill. June 26th, 1884.

A rubrum, Linn. On borders of swamps and in wet woods, common. In flower, May 22nd, 1884.

LEGUMINOSÆ.

Trifolium pratense, Linn. Cultivated fields. Introduced.

T. repens, Linn. Fields and roadsides, common. July 1st, 1884.

T. hybridum, Linn. In grass field at Layton's Intervale, July 2nd, 1884. Introduced.

Vicia sativa, Linn. Common in gardens and waste places around dwellings. August, 1884. Introduced.

V. Cracca, Linn. In grass fields, common. July 2nd, 1884.

Lathyrus palustris, Linn. In grass on the marsh, common. July 2nd, 1884.

ROSACEÆ.

Prunus Pennsylvanica, Linn. Wooded banks, Smith's Island, Bible Hill, etc., common. June 6th, 1884.

P. Virginiana, Linn. Borders of swamp around Smith's Island, June 23rd, 1884.

Spiræa salicifolia, Linn. Swamps and low grounds, common.

Agrimonia Eupatoria, Linn. Borders of woods at Smith's Island, common. Aug. 1884.

Gum Virginianum, Linn. Borders of woods at Lower Village, etc., common.

Potentilla Novegica, Linn. Dry pastures at Bible Hill. Smith's Island, &c., common. June 28th, 1884.

P. Canadensis, Linn. In grass fields and pastures, common June 23rd, 1884.

P. tridentata, Ait. In pastures at Lower Village. June 19th, 1884.

P. palustris, Scop. In swamps near Smith's Island. July, 1884.

Fragaria Virginianam, Ehrhart. In grass fields, also on border of woods, and in newly cleared land, common. May 28th, 1884.

Rubus triflorus, Richardson. In woods, Smith's Island, the Falls, etc., common. May 28th, 1884.

R. strigosus, Michx. Thickets, common. June 26th, 1884.

R. villosus, Ait. Wooded banks at borders of the marsh, common, June 30th, 1884.

Rosa Carolina, Linn. Borders of the swamp near Smith's Island, etc., common. July, 1883.

Cratægus tomentosa, Linn. Borders of swamp near Smith's Island. June 18th, 1884.

Pyrusarbutifolia, Linn. Edges of woods at Smith's Island, June 13th, 1884.

Amelanchier Canadensis. T. & G., var. *Botryapium.* Wooded banks and along the borders of swamps, common. May 28th, 1884.

A. C. var. *oblongifolia,* Gray. Wooded banks near Smith's Island. June 3rd, 1884.

SAXIFRAGACEÆ.

Ribes rotundifolium, Michx. Roadside of the old Pictou Road, Bible Hill. June 3rd, 1884.

R. lacustre, Poir. Swamps and wet woods at Bible Hill, Smith's Island, etc., common. June 3rd, 1884.

R. prostratum, L'Her. In swamps around Smith's Island, common. May 28th, 1884.

R. floridum, Linn. Low ground around McClure's Island in the little marsh. June 5th, 1884.

R. rubrum, Linn. Low grounds at McClure's Island. May 22nd, 1884.

Mitella nuda, Linn. In woods among moss, Smith's Island, the Falls, etc. June 9th, 1884.

Tiarella cordifolia, Linn. Hardwood banks, Bible Hill. June 11th, 1884.

Chrysosplenium Americanum, Schwein. In water, in swamps around Smith's Island. May 17th, 1884.

ONAGRACEÆ.

Circæa alpina, Linn. In woods back of Terrace Hill Cemetery.

Epilobium angustifolium, Linn. In newly cleared or burnt land, common. August 29th, 1884.

E. palustre, Linn, var., *lineare,* Gray. Borders of swamps at Smith's Island. August, 1884.

E. coloratum, Muhl. Wet fields near Terrace Hill Cemetery. August, 1884.

Œnothera biennis, Linn. Borders of cultivated fields, common. August, 1884.

Œ chrysantha, Michx. Dry pasture near Smith's Island. July 2nd, 1884. First in flower, June 29th, 1884.

Œ pumila, Linn, var. with larger and paler flowers. In dry pasture near Smith's Island. August. 1884.

UMBELLIFERÆ.

Sanicula Marilandica, Linn. In hardwoods at Bible Hill. June 28th, 1884.

Heracleum lanatum, Michx. Borders of roads and fields. Marsh.

Cicuta maculata, Linn. In swamp round Smith's Island, 1883.

Sium lineare, Michx. Ditches throughout the marsh, also in woods back of Terrace Hill Cemetery, common. August 27th, 1884.

Curum Carui, Linn. In grass fields and around dwellings, common. Introduced.

ARALIACEÆ.

Aralia hispida, Michx. Dry hills, near Terrace Hill Cemetery, common. August, 1883.

A. nudicaulis, Linn. Border of swamp near Smith's Island, June 11th, 1884.

A. trifolia, Gray. In woods on the road to Harmony, June 7th, 1884.

CORNACEÆ.

Cornus Canadensis, Linn. In woods, very common. June, 1-15th, 1884.

C. stolonifera, Michx. Borders of woods and of cultivated fields at Smith's Island. 1883.

C. paniculata, L'Her. Border of Swamp at Smith's Island. 1883.

CAPRIFOLIACEÆ.

Linnæa borealis, Gronov. In spruce woods, common. June 21st, 1884.

Lonicera ciliata, Muhl. In woods, Smith's Island, the Falls, etc., common. May 22nd, 1884.

L. cœrulea, Linn. Thicket at McClure's Island, May 31st, 1884.

Diervilla trifida, Moench. Borders of woods and in thickets, common. 1883.

Sambucus Canadensis, Linn. In thickets on roadside, Lower Village. 1883.

S. pubens, Michx. Wooded banks at Smith's Island, the Falls, etc., common. June 5th, 1884.

Viburnum Lentago, Linn. Borders of swamp around Smith's Island, etc., common. July, 1884.

V. lantanoides, Michx. Banks of ravine, back of Terrace Hill cemetery. June 9th, 1884.

RUBIACEÆ.

Galium asprellum, Michx. Low thickets at Smith's Island, etc. July, 1884.

G. trifidum, Linn. Wet places and borders of streams. Marsh. July, 1883.

Mitchella repens, Linn. Dry woods, common; Smith's Island, the Falls, etc. July 1883.

COMPOSITÆ.

Eupatorium purpureum, Linn. Wet places around the edge of the marsh, common. September, 1884.

Aster cordifolius, Linn. Woodlands, back of Terrace Hill Cemetery.

Erigeron Canadense, Linn. Waste places and roadsides, common. Sept., 1884.

E. strigosum, Muhl. Borders of woods and in fields, common. August, 1884.

Diplopappus umbellatus, Torr and Gray. Thickets, McClure's Island, and back of Terrace Hill Cemetery. Sept., 1884.

Rudbeckia hirta, Linn. In grass fields, rather scarce. July, 1884.

Bidens frondosa, Linn. Wet fields back of Terrace Hill Cemetery, August, 1884.

Bidens cernua, Linn. In swamp near Smith's Island. Sept. 1884.

B. chrysanthemoides, Michx. On borders of ditches throughout the marsh. September, 1884.

Achillæa Millefolium, Linn. Fields and roadsides, common.

Leucanthemum vulgare, Linn. In grass fields, very common. June 21st, 1884. Introduced.

Matricaria inodora, Linn. Common in waste places around dwellings. 1883. Introduced.

Tanacetum vulgare, Linn. Borders of cultivated fields. August 30th, 1884. Introduced.

Antennaria margaritacea, R. Brown. Dry pasture, east of Terrace Hill Cemetery. August, 1884.

A. plantaginifolia, Hook. Dry and barren fields at Smith's Island, the Falls, etc., common. June 9th, 1884.

Centaurea Cyanus, Linn. Waste places around dwellings, 1883. Introduced.

Circium lanceolatum, Scop. In pastures, common. Smith's Island Aug. 1884. Introduced.

C. arvense, Scop. In cultivated fields, pastures, roadsides, etc., everywhere common. Aug. 1884. Introduced.

Lappa officinalis, Allioni. Roadsides, and around dwellings common. August, 1884. Introduced.

Cichorium Intybus, Linn. Sparingly found in grass fields. 1883. Introduced.

Leontodon autumnale, Linn. Roadsides and pastures, common. August, 1884. Introduced.

Hieracium Canadense, Michx. In woods at Smith's Island, Aug., 1884.

H. scabrum, Michx. Dry fields and open places at Smith's Island. August, 1884.

Nabalus albus, Hook. Open woods at Smith's Island. Oct. 11th., 1884.

N. altissimus, Hook. Borders of woods, back of Terrace Hill Cemetery, also at Smith's Island. Aug. 27th, 1884.

Taraxacum Dens-leonis, Desf. Pastures and fields, everywhere. May 15th, 1884.

Sonchus asper, Vill. Waste places around dwellings. 1883. Introduced.

LOBELIACEÆ.

Lobelia inflata, Linn. Roadsides and dry fields, common June, 1884.

CAMPANULACEÆ.

Campanula rotundifolia, Linn. In grass fields near the Salmon River bridge at Bible Hill, July 1st., 1884.

ERICACEÆ.

Vaccinium Vitis-Idæa, Linn. Dry pasture at Lower Village, June 18th, 1884.

V. Canadense, Kalm. Dry woods at Smith's Island, Lower Village, etc., common. June 3rd, 1884.

V. vacillans, Solander. Dry woods and open places at McClure's Island, Smith's Island, etc., common. June 5th, 1884.

Chiogenes hispidula, Torr. and Gray. In mossy swamps, Lower Village, Smith's Island, etc., common. May 14th. 1884.

Epigæa repens, Linn. In woods, common. Lower Village, the Falls, Smith's Island, etc. April 29th, 1884.

Gaultheria procumbens, Linn. In spruce woods, common. July, 1884.

Cassandra calyculata, Don. In swamp at Smith's Island, May 17th, 1884.

Kalmia angustifolia, Linn. In newly cleared land near Terrace Hill Cemetery, July, 1884.

Rhodora Canadensis, Linn. Common in newly cleared lands.

Ledum latifolium, Ait. In swamp at Smith's Island. June 19th, 1884.

Pyrola rotundifolia, Linn. Open woods at Smith's Island. June 29th, 1884.

Var. *uliginosa*, (with large flowers.) Banks of a ravine at Bible Hill. June 28th, 1884.

P. elliptica, Nutt. Woods at the Falls. 1883.

Monesis uniflora, Gray. In damp woods, The Falls, Smith's Island, etc., common. June 23rd, 1884.

Monotropa uniflora, Linn. In mossy woods, back of Terrace Hill, also at Smith's Island. Aug. 27th, 1884.

AQUIFOLIACEÆ.

Ilex verticillata, Gray. McClure's Island, growing in wet ground bordering on the marsh. 1883.

PLANTAGINACEÆ.

Plantago major, Linn. Fields, roadsides, etc., common. July, 1883.

PRIMULACEÆ.

Trientalis Americana, Pursh. In woods, common. Smith's Island, the Falls, etc. June 9th, 1884.

Lysimachia thyrsiflora, Linn. In swamp around Smith's Island, July 1st, 1884.

L. stricta, Ait. Low grounds round the marsh. Aug., 1883.

L. ciliata, Linn. Edges of gullies in the marsh, July, 1884.

SCROPHULARIACEÆ.

Verbascum Thapsus, Linn. Barren pastures and on the railroad bed, common. August, 1883. Introduced.

Linaria vulgaris, Mill. Roadside at Willow Street. 1883. Introduced.

Chelone glabra, Linn. Swamps round Smith's Island, common. August, 1884.

Mimulus ringens, Linn. Edges of gullies in the marsh. July, 1883.

Veronica Americana, Schweinitz. In a brook back of Terrace Hill Cemetery, also, ditches in the marsh. June 23rd, 1884.

V. scutellata, Linn. Swamps around Smith's Island, June 23rd, 1884.

V. serpyllifolia, Linn. In grass fields and roadsides, common. June 4th, 1884.

V. arvensis, Linn. Cultivated grounds around dwellings. Sept., 1884. Introduced.

Rhinanthus Crista-galli, Linn. In grass fields, common. July 1st, 1884.

Melampyrum Americanum, Michx. In woods at Smith's Island. July, 1883.

LABIATÆ.

Mentha aquatica, Linn. Gravelly bed of the Mill Brook in the marsh. August, 1884. Introduced.

M. Canadensis, Linn. Swamps, common. Smith's Island, etc. Aug. 1884.

Lycopus Virginicus, Linn. Banks of the Mill Brook. Aug. 1884.

Calamintha Clinopodium, Benth. In the marsh around McClure's Island. Aug. 1884.

Nepeta Glechoma, Benth. Roadsides at Truro and Lower Village. May 31st, 1884.

Brunella vulgaris, Linn. Damp woods near Terrace Hill Cemetery, also in fields, common. Aug. 1884.

Scutellaria galericulata, Linn. Ravine back of Terrace Hill Cemetery. Aug., 1883.

S. lateriflora, Linn. Swamp at Smith's Island, common. Aug., 1884.

Galeopsis Tetrahit, Linn. Waste places and cultivated grounds, common. Aug., 1884. Introduced.

Leonurus Cardiaca, Linn. Waste places around dwellings. Aug., 1884. Introduced.

BORRAGINACEÆ.

Myosotis palustris, Withering, var., *laxa*, Gray. Swamps around Smith's Island; and borders of ditches in the marsh, common. June 23rd, 1884.

CONVOLVULACEÆ.

Calystegia Sepium, R. Br. Banks of the Mill Brook flowing through the marsh. Common. July, 1883.

GENTIANACEÆ.

Menyanthes trifoliata, Linn. Wet paces in the Little Marsh. June 7th, 1884.

APOCYNACEÆ.

Apocynum androsæmifolium, Linn. McClure's Island, 1883.

CHENOPODIACEÆ.

Chenopodium album, Linn. Cultivated grounds, common. Introduced.

POLYGONACEÆ.

Polygonum Persicaria, Linn. Low grounds near Smith's Island. August, 1883. Introduced.

P. arifolium, Linn. Marsh at Smith's Island. July, 1883.

Rumex verticillatus, Linn. Borders of gullies in the marsh. Sept., 1884.

R. Acetosella, Linn. In poor grass fields, common. June 23rd, 1884. Introduced.

URTICACEÆ,

Ulmus Americana, Linn. Along the banks of the Salmon River. 1884.

CUPULIFERÆ.

Fagus ferruginea, Ait. Woods on the old Halifax road, Smith's Mills.

Corylus rostrata, Ait. Smith's Island, McClure's Island, etc. common.

MYRICACEÆ.

Myrica Gale, Linn. Border of pond near Smith's Island, May 3rd, 1884.

Comptonia asplenifolia, Ait. Smith's Island, common. May 28th., 1884.

BETULACEÆ.

Betula alba, var., *populifolia,* Spach. Common in hardwoods near Truro. 1883.

B. papyracea, Ait. Hardwoods around Truro.

Alnus incana, Willd. Swamps and along the banks of streams, common.

CONIFERÆ.

Pinus Strobus, Linn. Smith's Island.

Abies nigra, Poir. Smith's Island, the Falls, etc., common all around Truro.

A. Canadensis, Michx. Common all around Truro.

A. balsamea, Marshall. Woods at Smith's Island, the Falls, etc., common.

Larix Americana, Michx. Swamps, common.

ARACEÆ.

Arisæma triphyllum, Torr. Swamps around Smith's Island. June 3rd, 1884.

Calla palustris, Linn. Pond near Smith's Island. June 11th, 1884.

Acorus Calumus, Linn. Wet places in the marsh. June, 1884,

ALISMACEÆ.

Triglochin maritimum, Linn. Marsh. August, 1884.

Alisma Plantago, Linn., var. *Americanum*, Gray. In ditches in the marsh. Sept , 1884.

Sagittaria variabilis, Engelm. In ditches and gullies in the marsh. July, 1883.

ORCHIDACEÆ.

Habenaria hyperborea, R. Br. Borders of marsh around McClure's Island. June 23rd, 1884.

H. dilatata, Gray. Borders of marsh around McClure's Island, June 23, 1884.

H. lacera, R. Br. Ravine back of Terrace Hill Cemetery. July, 1883.

H. psycodes, Gray. Intervale near Smith's Island, July, 1883.

Spiranthes cernua, Richard. Border of woods back of Terrace Hill Cemetery ; also Smith's Island, etc., common. August, 1884.

S. gracilis, Bigelow. In wet pastures on Halifax Road. common. Aug., 1883.

Corallorhiza innata, R. Brown. Open woods at Smith's Island. June 13th, 1884.

IRIDACEÆ.

Iris versicolor, Linn. Common in wet places in the marsh. June, 1884.

Sisyrinchium Bermudiana, Linn. In grass fields, common. June 16th, 1884.

LILIACEÆ.

Trillium cernuum, Linn. McClure's Island. June 5th, 1884.

T. erythrocarpum, Michx. Banks of the swamp around Smith's Island, rare, but common on the Pictou road, about four miles from Truro. May 26th, 1884.

Uvularia sessilifolia, Linn. Borders of gullies in the marsh, June 5th, 1884.

Streptopus roseus, Michx. In woods, common, the Falls, Bible Hill, etc.

Clintonia borealis, Raf. Common in woods everywhere around Truro, June 13th, 1884.

Smilacina trifolia, Desf. Swamps on the right hand side of the road leading to Terrace Hill Cemetery. June 14th, 1884.

S. bifolia, Ker. Woods at Smith's Island, the Falls, common. June 11th, 1884.

Polygonatum biflorum, Ell. Banks of Ravine back of Terrace Hill Cemetery, also at Bible Hill, June 11th, 1884.

Lilium Canadense, Linn. Along the banks of the Salmon River near Bible Hill; also in marsh near McClure's Island. July, 1883.

Erythronium Americanum, Smith. In woods at the Falls, scarce. May, 1883.

JUNCACEÆ.

Luzula pilosa, Willd. In woods at Smith's Island. May 14th, 1884.

L. campestris, DC. In grass fields and on borders of woods. May 26th, 1884.

Juncus effusus, Linn. Swampy ground near Smith's Island, also in wet places everywhere, common. Sept., 1884.

J. filiformis, Linn. In the marsh. June, 1884.

J. tenuis, Willd. Low wet fields and in the marsh, common.

CYPERACEÆ.

Dulichium spathaceum, Pers. Border of pond near Smith's Island. Sept. 8th, 1884.

Eleocharis palustris, R. Br. Borders of gullies in the marsh.

E. tenuis, Schultes. Wet places in the marsh. June, 1884.

Scirpus validus, Vahl. Swamps, and in gullies in the marsh. Sept., 1884.

S. atrovirens, Muhl. Wet places in the marsh, July, 1884.

Eriophorum polystachyon, Linn. In swamps and bogs, common, June 14th, 1884.

Carex vulgaris, Fries. Swamps and roadsides, Smith's Island, Bible Hill, etc., common. June 3rd, 1884.

C. oligosperma, Michx. In the marsh, common. June 11th, 1884.

EQUISETACEÆ.

Equisetum arvense, Linn. Gravelly bed of the railroad, common. May 14th, 1884.

E. sylvaticum, Linn. In wet woods around Truro, common. May, 1884.

E hyemale, Linn. Wet banks at Bible Hill. June, 1884.

E. scirpoides, Michx. Wooded banks at Bible Hill. June, 1884.

FILICES.

Polypodium vulgare, Linn. On rocks at the Falls, common. August.

Pteris aquilina, Linn. In pastures and newly cleared land. August, 1884.

Asplenium Filx-fœmina, Bernh. In wet woods, the Falls, Smith's Island, etc., common. August, 1884.

P. Dryopteris, Fee. In woods, Smith's Island, the Falls, etc., common. July, 1884.

Aspidium Thelypteris, Swartz. Swamps around Smith's Island, and in marsh, common. July, 1883.

A. Noveboracense, Swartz. In woods about a mile back of Terrace Hill Cemetery, not common. July, 1884.

A. spinulosum, Swartz. Wooded banks at the Falls, common. Sept., 1884.

Var., *dilatatum*. Common everywhere in woods around Truro.

A. cristatum, Swartz. In swamps, common. Smith's Island, etc. August, 1884.

A. maginale, Swartz. On rocky banks at the Falls, common, also in ravine back of Terrace Hill. July, 1884.

A. acrostichoides, Swartz. In woods, common. Smith's Island, the Falls, etc. July 3rd, 1884.

Cystopteris fragilis, Bernh. Side of the rocky bank just above the Falls, Rare. July, 1884.

Struthiopteris Germanica, Willd. Wet places at the foot of the bank, Bible Hill; also in the woods about one mile back of Terrace Hill Cemetery.

Onoclea sensibilis, Linn. Along the borders of gullies and in wet places in the marsh. Sept., 1884.

Dicksonia punctilobula, Kunze. In woods at the Falls; on roadsides, and in bunches in fields at Bible Hill, common. August, 1884.

Osmunda regalis, Linn. In swamps around Smith's Island, June, 1884.

O. Claytoniana, Linn. Wooded banks, Terrace Hill Cemetery, the Falls, etc., common. June 16th, 1884.

O. cinnamomea, Linn. In swamps and wet pastures, Smith's Island, Bible Hill, etc., common. June, 1884.

Botrychium lunarioides, Swartz. In old pastures and on dry hills, common; Smith's Island, Halifax Road, Terrace Hill, etc. August, 1884.

Var. obliquum, Gray. With the preceding but not so abundant.

Var. dissectum, Gray. With the preceding but not so abundant.

Ophioglossum vulgatum, Linn. In wet pastures on the east side of the Halifax Road, about half a mile from the Court House. Sept., 1884.

LYCOPODIACEÆ.

Lycopodium annotinum, Linn. In woods, Lower Village, also on the Harmony road. August, 1884.

L. dendroideum. Michx. In spruce woods, common. Sept., 1884.

L. clavatum, Linn. Woods and pastures, common. Sept., 1884; also variety bearing but a single spike, in a pasture on the Halifax Road.

L. complanatum, Linn. Borders of woods near Terrace Hill Cemetery, Sept., 1884.

As an addendum to the preceding List, the following plants may be noticed as having been collected during the last two seasons in other parts of the Province:—

Anemone nemorosa, Linn. River bank at Middle Stewiacke, May 27th, 1884.

Sarracenia purpurea, Linn. Peat bogs at Cow Bay, C. B. July, 1884.

Dicentra Cucullaria, DC. Debert Mills, Col. Co., May 24th, 1884.

Drosera rotundifolia, Linn. Bog at Cow Bay, C. B., July, 1884.

Claytonia Caroliniana, Michx. Debert Mills, Colchester Co. May 24th, 1884.

Spiræa tomentosa, Linn. Tatamagouche, Sept., 1884.

Geum rivale, Linn. Banks of the Mill Brook, Brookfield, Col. Co., June 7th, 1884.

Rubus Canadensis, Linn. Sydney Mines, C. B., July, 1884.

Rosa lucida, Ehrhart. Sydney Mines, C. B., July, 1884.

R. rubiginosa, Linn. Banks of the French River, Tatamagouche, July, 1883. Introduced.

Gaylussacia resinosa, Torr. & Gray. Tatamagouche, July, 1883.

Vaccinium macrocarpon, Ait. Sydney Mines, C. B. Common. July, 1884.

Plantago maritima, Linn. Old Battery at Sydney Mines, C. B., July, 1884.

Euphrasia officinalis, Linn. Tatamagouche and Sydney Mines, 1884.

Polygonum dumetorum, Linn. French River, Tatamagouche Aug., 1883.

Empetrum nigrum, Linn. Sydney Mines, C. B., July, 1884.

Myrica cerifera, Linn. Sydney Mines, C. B., July, 1884.

Habenaria tridentata, Hook. Cow Bay, C. B., July, 1884.

H. blephariglottis, Hook. Cow Bay, C. B., July, 1884.

Calopogon pulchellus, R. Br. Peat bog at Cow Bay, C. B., July, 1884.

Microstylis monophyllos, Lindl. Bank of the French River, Tatamagouche, 1884.

Cypripedium acaule, Ait. New Annan Mountain, on the road between Truro and Tatamagouche, June 20th, 1884.

Medeola Virginica, Linn. New Annan Mountain, June, 1884.,

Pontederia cordata, Ait. Sydney Mines, C. B., July, 1884.

Aspidium acrostichoides, Swartz. var. *incisum*. Bank of the French River, Tatamagouche, Sept. 11th, 1884.

ART. VII.—NOTE ON TEMPERATURES OF MAXIMUM DENSITY. BY PROF. J. G. MACGREGOR.

(Read May.)

KOHLRAUSCH* has investigated the expansion of Vulcanite (Hartgummi, Kammmasse,) and found that between 16° and 35° C the true linear coefficient of expansion *(e)* at the temperature t is given by the formula:

$$e = 61 \times 10^{-6} + 76 \times 10^{-8}\, t$$

If the formula hold beyond the experimental limits, it follows that e must have the value o, when

$$t = -81.^{\circ}7\ C.$$

For higher values of t, e will be positive; for lower values it will be negative. At this temperature, therefore, Vulcanite must have minimum volume or maximum density, if the above formula holds. The probability that the formula deduced from experiments between +16° and +35° should be true for —80° is not great, but it may, nevertheless, be worthy of notice that it indicates vulcanite as being perhaps one of those peculiar substances having temperatures of maximum or minimum density.

The following substances have also laws of expansion within the limits of experiment, which indicate temperatures of maximum or minimum density beyond these limits:

	Temperature of Maximum Density.	Temperature of Minimum Density.
Diamond†	—41° . 9 C	....
Copper Oxide†	— 4 . 3	....
Emerald†	— 4 . 2	....
Iodide of Silver‡ (crystal)		—137° C
Do. (cast)		— 59.3
Do. (compressed precipitate)		— 45.4

* Pogg. Ann. Phys. Chem.—cxlix (1873), p. 577.

† Fizeau, Comp. Rend. lxviii., p. 1125 (Pogg. Ann. Phys. Chem., cxxxviii. (1869), p. 26.

‡ Fizeau, Comp. Rend., lxiv. (1867), pp. 314 and 771—(Pogg. Ann. Phys. Chem., cxxxii (1867) p. 292.)

I may add a table of the substances which have temperatures of maximum or minimum density within the limits of experiment:

	Temperature of Maximum Density.	Temperature of Minimum Density.
Darcet's Metal* (Bi_{13} Sn_{10} Pb_8)	50° C	35° C
Iodide of Silver†	145.5	....
Iodides of Silver & Lead (alloy)‡	141	121
Lipowitz's Metal* (Bi_{11} Pb_6 Cd_4 Sn_5)	40	25
Rose's Metal (Spring)* (Bi_7 Sn_6 Pb_4)	55	40
Wood's Metal* (Bi_4 Pb Cd_2 Sn_2)	35	..

* Spring, Ann Chim. Phys. (5) vii. (1876) p. 178

† Rodwell, Proc. Roy. Soc., Lond., xxv. p. 272.

‡ Rodwell, Proc. Roy. Soc., Lond., xxxii (1881) p. 540.

ART. VIII.—NOVA SCOTIAN ICHTHYOLOGY.—ADDITION TO JONES' CATALOGUE OF 1879 TRANS. BY REV. D. HONEYMAN, D. C. L.

(Read May 11, 1885.)

SINCE the above catalogue was published, some fishes of interesting character, not to be found in that list, have been added to the collection of the Provincial Museum. To these I now propose to direct attention.

I.

Black Pilot,—*Palinurus perciformis.* Fam. *Scombridae.* DeRoy.

Black Rudder-fish,—*Palinurichthys perciformis.* Fam. *Stromateidae.* Gill.

Rudder-fish or Perch Coryphene,—*Coryphaena perciformis.* Mitchell, *Trachynotus argenteus.* Storer.

Two specimens were brought to the Museum some years ago by a fisherman of Devil's Island. I identified them by consulting DeKay. They were in a state of decay. Last autumn the same brought me two other specimens. These are of larger size than two preceding, and are now in pretty fair condition preserved in alcohol. The first were of the same size as that described by DeKay,—9 inches. The last are of larger size, one being 11 inches, the other 13. They are, probably, male and female.

I give from DeKay's description, the leading characteristics applicable to our specimens. "Colour black, body oblong, elliptical compressed. Height nearly equal to one-third of length. Lateral line commences at the upper angle of the branchial aperture, is arched, and nearly concurrent with the back, from which it is little distant. Head declivous somewhat rounded. Opercle with a pointed membrane. Pre-opercle, with sub-equal short spines, gives the bone on its outer surface a plaited appearance.

Jaws sub-equal, the lower shutting within the upper. A series of small sub-conical, slightly recurved teeth. The dorsal fin is compound; the anterior portion consists of seven short acute spinous rays, connected with each other by a low membrane, and the whole lodged in a deep grove," &c. "Maine to Hatteras,"—Gill. *Halifax Banks.*

II.

Banded Seriole. Sp. *Seriolo Zonata.* Gen. *Seriola* (Cuvier and Valencienne), and Fam *Scombridae.*—DeKay.

The prominent characteristic of our specimen is its six broad vertical bands. The body is fusiform compressed. The first dorsal fin is spinous. It has no finlets. Its length is eight inches. In other respects also it agrees with DeKay's description.

The same fisherman brought this specimen to the Museum. It also was caught on the banks, south of Devil's Island.

III.

INCERTÆ SEDIS.

In this category I place the strange fish that was found at Cole Harbor. A description of it is to be found in the Appendix to Transactions 1882-3. It is in our Museum. I had it photographed and submitted, with said description, to the Biological section of the British Association, at its meeting in Montreal, 1884. I expected in so doing to get some light in reference to its name and zoological relations. It appears from the reports that no opinion was expressed in reference to its character. There was some discussion regarding the title of my note—"A supposed Deep-sea Fish." I meant by this that it was *supposed* to belong to what Gunther calls "Deep-sea Fishes"—introduction pages 296 to 311. I unintentionally omitted (?) I have sent copies of the photo to Washington and London. As no opinion has since been given, I conclude that our specimen is a "strange fish," and consequently *incertae sedis.*

IV.

Bluish sea lamprey. *Petromyzon nigricans* Family *Petromyzontidae.* Black lamprey. *Ammo ecetus nigricans* (Lesneur). Fam *Petromyzontidae,* class Marsipobranchiae. 1st family *Petromyzontidae* III sub-class.

Of this we have three specimens, one is *bluish* and two are *black.* The first is eight inches in length, the other two are between six and seven.

"Body eel-shaped, naked—subject to metamorphosis; in the perfect stage with a suctorial mouth armed with teeth, horny sitting on a soft papilla; lingual and suctorial teeth may be distinguished. Eyes present (in mature animals). External nasal aperture in the middle of the upper side of the head. The nasal duct terminates without perforating the palate. Seven branchial sacs and apertures on each side, behind the head. The inner branchial ducts terminate in a separate common tube. They feed on fishes to which they suck themselves fast, scraping off the flesh with their teeth. Whilst thus engaged they are carried about with their victim."—Gunther.

They are found attached to mackerel, haddock and cod.—"Cape Cod to Cape Hatteras."—Gill, Halifax.

These are altogether different from the *Petromyzon marinus* of our *Catalogue.—Trans. 1879*

V.

Hag-fish. *Myxine Glutinosa.* Family *Myxinidae* III subclass. *Cyclostomata.—Gunther.*

Hags. Family *Myxinidae.* Ord. *Marsipobranchii.* Class *Pisces.—Huxley.*

Hag-fish. Sucker. Slime-fish. *Myxine glutinosa* (Linn). Family *Myxinidae.* Ord. 12 *Hyperotreta.* Class C. *Marsipobranchii.—Gill.*

"Body eel-shaped, naked. The single nasal aperture is above the mouth, quite at the extremity of the head, which is provided with four pairs of barbels. Mouth without lips. Nasal duct without cartilaginous rings penetrating the palate. One medium tooth on the palate, and two comb-like series of teeth on the tongue. Branchial apertures at a great distance from the head. The inner branchial ducts lead into the æsophagus. A series of mucous sacs along each side of the abdomen. Intestines without special value."—*Gunther.*

In the naturalist's library it is called *Gasterobranchus cæcus.* It is so named as its *gills* are on the *belly,* and as it is blind. Huxley places in the order *Marsipobranchii—Marsipos* a pouch *branchia gills,* as its "gills are sac-like, not ciliated."—*(Introduction to the Classification of Animals*—London, 1869. Gunther says—"Its eyes are rudimentary, and are covered with the muscles and skin." Linnæus at first classed it among his order *Vermes.* Worms—*Nat. Lib.*

One specimen was brought to the Museum by another Devil's Island fisherman. He caught it at a distance of 70 miles from the island, and in depth of 54 fathoms. It was twisted round a trawl hook. When brought it was living, and very active. It had secreted a large quantity of slime in the tin can. Its lamprey affinities were readily recognized from its eel-shape and the form of its mouth. I put it into a large glass jar, and filled it with fresh sea-water, that I might keep it alive and study its movements. It lay quiet at the bottom for nearly an hour, during this time it secreted a large quantity of slime. Lifting it up in the vessel, it became quite active, wriggling and moving its barbels. On referring to Gillis' Catalogue of Fishes, I readily identified it as *Myxine Glutinosa* slime-fish. Referring also to vol. 37 of the Naturalist's Library, I found a picture of myxine, which, in its main features, depicts our specimen. Consulting Gunther, the identification was complete.

Next morning I found it dead and suspended in the water.

It is 18 inches in length. Its girth near the two branchial apertures is two inches. The nostril at the extremity of the head has two pairs of barbels; two pairs are at the mouth. The distance of the branchial apertures from the nostril is $5\frac{1}{2}$ inches. Its colour is light brown,—lighter on the abdomen. On either side there is a line of mucous sacs. The vent is two inches from the caudal extremity. It is blind. "The eight barbels, or cirri, are, there is no doubt, delicate organs of touch, by which the myxine obtains cognizance of the nature and quality of the substances with which they are in contact, and the single-hooked tooth on the palate enables it to retain its hold until the double row of lingual teeth are brought into action to aid the desire to obtain a good meal. Distribution. "Polar Regions to Cape Cod."—*Gill.*

"They are marine fishes, with a similar distribution as the *Gadidae,* being most plentiful in the higher latitudes of the temperate zones of the northern and southern hemispheres.

They are frequently found buried in the abdominal cavity of other fishes, especially gadoids, into which they penetrate to feed on their flesh. They secrete a thick gelatinous slime in incredible quantities, and are therefore considered by fishermen a great nuisance, seriously damaging the fisheries, and interfering with the fishing in localities where they abound.

Myxine descends to a depth of 345 fathoms, and is generally met with in the Norwegian Fjords at 70 fathoms, sometimes in great abundance."—*Gunther.*

PALÆONTOLOGICAL.

Some zoologists and palæontologists consider that myxine, on account of its low organization and habits, must have been among the first fishes that appeared in our world, and that its lingual teeth, as the only parts that could survive, may yet be found in Silurian or Devonian strata.

ART. IX.—NOTES ON THE FRESH WATER SPONGES OF NOVA SCOTIA. BY A. H. MACKAY, B. A., B. SC.

WHEN examining the diatomaceous deposits of our lakes, we always found present in greater or less abundance the silicious spicules of fresh water sponges. In some of the material examined there appeared to be even a greater amount of silica deposited as sponge spicules than as diatom cells. A search for the origin of this spicular deposit, has revealed, up to date, the existence of *four* genera containing *nine* species of fresh water sponges, which form a part of the living fauna of Nova Scotia. In the summer of 1884, in company with Hector McInnes, Esq., of the Pictou Academy, and John H. MacKay, Esq., Principal of the River John High School, we made a most enjoyable exploration of the physical and natural history characters of the lakes in the basin of the East River of Pictou and beyond the watershed of the Province on the upper sources of the St. Mary's on the Atlantic slope. We constructed rafts when necessary, so as to be able to take soundings of their depths, and dredgings from various parts of their bottoms. This paper is simply an outline and classification of the species of *spongillina* found on this expedition.

Fresh water sponges are generally rather inconspicuous objects. The first reference to them in a printed work appears to have been made in 1696. Linnæus described two species in 1745, under the names *Spongia lacustris* and *S. fluviatilis*. In 1816 the name *spongilla* was given the genus by Lamarck. In 1839, Meyen pointed out the peculiar spiculation surrounding the "seed-like" bodies of one of these two species (our *Meyenia fluviatilis*, see slides 26 and 27). In 1840 Hogg demonstrated that these "seed-like bodies" germinated and reproduced the spongilla. In 1867 Carter established the "animality" of these sponges. Lieberkuhn and Bowerbank, by means of the spiculation of what the latter called "ovaries," definitely distinguished between the two known forms at that time, naming them respectively *Spongilla lacustris* and *fluviatilis* (now, *Meynia fluviatilis*). The macroscopic characters of fresh water sponges are often so variable or ill-defined that a microscopic examination of the general structure of the reproductive gemmule which Carter denominates a "statoblast," is necessary to make sure of its identity. Accordingly, Carter, in 1881, divided the fresh water sponges then known to science into five genera, each of which is distinctly characterized by the spiculation.

In Canada, Sir William Dawson, of McGill, in 1863, sent a specimen of freshwater sponge to Bowerbank, who described it under the name of *S. Dawsoni*. In 1875, George M. Dawson, son of Sir William, described four additional sponges as new to Canada and science. Although these are not likely to rank as species in the future system of classification, they mark a good step in the advance of our knowledge of these organisms by one whose energy and encyclopædic knowledge of Canadian Natural History have done much, and promise to do still more, in bringing our Dominion under the notice of the scientific world.

Our freshwater sponges are, so far as observed, generally greenish, poriferous or variously channelled masses, of a rather soft,but not fluid sarcode, supported by a skeleton of silicious spicules, or needles, approximating the one hundredth of an inch in length, variously combined to form a mesh-work structure, which may assume the contour of thin or thick encrusting layers, even or lobed, in some species branching erect, or creeping in slender filaments. The statoblasts which appear to mature before winter, commonly in the basal portion of the sponge, are more or less spherical, smaller than the head of a pin, variable as to size and mode of aggregation, and contain a mass of free cellular germinal matter, which is enclosed by a strong chitinous membrane, with a small variously formed and directed aperture. The chitinous coat is surrounded by an outer structure, generally densely charged with a regularly arranged investing layer of characteristic spicules, in most species bearing no resemblance either in form or size to the skeletal spicules.

It is upon the distinct and invariable characters of this statoblast spiculation that the modern genera are based. Some sponges have a third class of spicules on the surface and in the interstitial spaces or flesh. They are always slender, and very much smaller than the skeletal spicules. Nearly all the sponges taken in Nova Scotia have been of some shade of green when living and exposed to the influence of light. When attached to the under side of stones so as to be excluded from the light, they become whitish. When dried rapidly, most of the sponges shrink considerably, yet preserve their approximate form and colour without decomposition. Exposure to light, however, soon destroys the green of the dried sponge. The great bulk of the specimens secured have been taken from water varying from a few inches to seven or eight feet. Specimens have been taken from between thirty and forty feet of water by the dredge. They grow attached to submerged pieces of wood, bark, weeds, stones, gravel, and even on ferruginous concretions. Water liable to become turbid is unfavourable to their development. The largest specimen was one of *Meyenia fluviatilis*, taken from a depth of seven or eight feet, in the Garden of Eden Lake, Pictou County, on the 1st of August. It was encrusting a small branch of about one inch in thickness, which was projecting from a submerged tree. It was fusiform in contour,—the greatest diameter being four inches, and its length twenty-seven inches. During winter these sponges generally die, and the most of their spicules are scattered in the neighboring deposits. The statoblasts are also often drifted about, and germinate the following spring when a congenial environment is found.

We give the following systematic outline descriptions of the species collected:

Genus I. SPONGILLA.

Statoblasts, more or less spherical, single or aggregated in larger masses about the size of a head of a pin, invested with linear spicules, straight or curved, cylindrical or acerate, more or less spined and arranged tangentially to the chitinous coat of the statoblast.

I. *S. fragilis.* Leidy.

Sessile, encrusting. Statoblasts in extensive basal layers, with apertures extended into generally curved tubules, directed outwards, or aggregated into compound spherules of three or four or more single statoblasts in a common cellular investment with spicules, cylindrical, roundish truncate, spined and generally slightly curved.

Described first by Leidy, 1851; by Bowerbank as *S. Lordii* from British Columbia in 1863; by Dybowski as *S. Siberica* in Russia. The varying forms with aggregated or compound statoblasts, were described as *Var. Segregata*, by Potts; but he says a wider experience has induced him to give it up. It is this form which has been described from the Ottawa, by Dr. G. M. Dawson, in 1875, as *S. Ottawaensis.* His "large irregular ovaria" are the compound statoblasts to the structure of which he does not allude. These forms are frequently found encrusting submerged twigs, stones, &c., in the lakes of Nova Scotia. (See slides 20 and 21.)

2. *S. lacustris Var. Dawsoni, Bk.*

Generally branching. Besides the skeletal spicules there are present minute, spined, fusiform dermal arcuates. Statoblast spicules, cylindrical, spined and more or less curved.

This is a variety of the European *S. lacustris.* The first Canadian species was described by Bowerbank in 1863 as *S. Dawsoni.* Next we find *S. lacustroides.* Then as its specific identity with the European form become apparent, we find *S. lacustris* var. *lacustroides* Potts, and *S. lacustris* var. *Americana* Carter. We suggest the propriety of retaining Bowerbank's specific as the varietal name. We have a specimen from Sir William Dawson, collected by H. M. Ami in the Ottawa, which is nearly identical with the European *S. lacustris.*

One of the most common of Nova Scotian fresh water sponges. (See slides 22 and 23.)

3. *S. Mackayi*, Carter.

Sessile, encrusting, with many large compound statoblasts prominent through the thin layer of flesh. Large gemmules $\frac{1}{12}$ inch in diameter consisting of about 16 statoblasts, apertures turned inward, supported by a mass of heavily spined acerate spicules of various sizes, intercrossing. Spines sometimes as long as the spicule is broad, very irregular in size and situation, skeletal spicules longer and all parts more slender. Described by Carter, in the "Annals and Magazine of Natural History." London, January, 1885. The species is not uncommon in Nova Scotia lakes. Its spicules appear to exist in the diatomaceous deposits of the lakes which supply the water system of Halifax; specimens of which we have received from Professor Lawson of Dalhousie College. Carter has described similar spicules as abundant in the diluvial deposits of the Altmühl Valley in Bavaria. (See slides 24 and 25.) It is very near *S. igloiformis* of Potts.

Genus II.—Meyenia.

Statoblasts surrounded by minute *birotulate* spicules.

4. *M. fluviatilis*, Carter.

Massive encrusting, sometimes extensively lobular. Birotulates small and star-like, the shaft connecting the rayed discs about equal to diameter of rays.

Varieties of this species (with some adventitious spicules) have been described by Dr. G. M. Dawson in the Canadian Naturalist of Sept., 1875, as *S. stagnalis* and *S. asperrima*. This species, like its old European comrade, *S. lacustris*, is one of our most common sponges. (See slides 26 and 27).

5. *M. Everetti*, Mills.

Sessile, encrusting. Statoblast birotules 3 to 4 times longer axially than those of *M. fluviatilis*, with the more numerous rays incurved. Flesh spicules present as minute slender birotules with incurved barb-like rays. Discovered for the second time in the lakes of Pictou County. The only habitat previously known is a lake on Mount Everett, Berkeshire Co., Mass., U. S. A., 1800 or 2000 feet above the sea. The flesh spicules of this species have been observed in the diatomaceous deposits of the lakes which supply the city of Halifax with water. (See slides 28, 29 and 30).

Genus III.—Heteromeyenia.

Statoblast birotules of two orders, one long, the other short.

6. *H. Ryderi*, Potts.

Rather massive with lobular protuberances. Long birotules, with scattered spines on shaft and few incurved, nearly barb-like, rays. Short birotules, with small shaft enlarging towards the large finely-toothed discs. (For structure and spiculation see slides 31, 32 and 33). Very abundant in MacKay's Lake, Pictou Co.

7. *H. argyrosperma*, Potts.

Sessile, encrusting. Large birotules more than twice the size of those of *H. Ryderi*, rays more hook-like. Small birotules about half the length ; few rays irregularly hooked ; shaft with stout scattered spines. In Garden of Eden Lake, Pictou Co., and adjacent lakes.

8. *H. Pictovensis*, Potts.

Sponge light green, massive, encrusting; texture very compact; spicules non-fasciculated, persistent; surface mostly smooth and firm to the touch. Statoblasts very scarce, spherical; crust thick.

Skeleton spicules cylindrical, short, robust, rounded or abruptly terminated; entirely spined,—spines conical at the centre of the spicule, elsewhere generally curving towards each extremity; rounded terminations of spicules covered with short spines, though frequently a single large spine or acute termination is seen at one or both extremities.

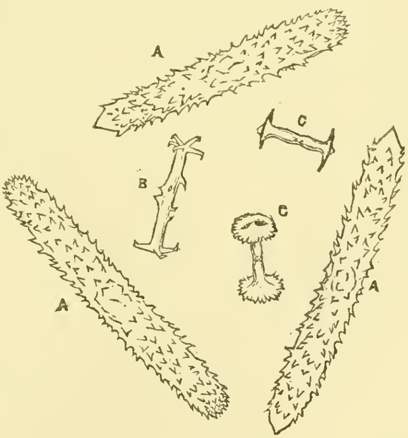
Birotulates of the longer class surrounding the statoblasts, rather numerous, one-half longer than the others; shafts conspicuously fusiform or largest at the centre, where are found one or more long spines. Their rotules consist of three to six irregularly placed rays, recurved at the extremities.

Birotules of the shorter class abundant, and compactly placed around the statoblasts; shafts mostly smooth, though sometimes bearing a single spine; irregularly cyndrical, but rapidly widening to support the rotules, which are large, umbonate, nearly flat, and finely lacinulate at their margins; occasionally bearing spines.

Measurements—Skeleton spicules 0.0075 inch long, by 0.00075 inch thick; length of long birotulates 0.0021 inch; of short birotulates 0.0012 inch; diameter of disc of latter, 0.0009 inch.

The above description is substantially that of Mr. Potts, who described the species before the Philadelphia Academy of Natural Sciences, at its meeting of February 24th, 1885.

This most beautiful of all our sponges was originally found in the lakes of the watershed of the Province, between Pictou, Guysboro' and Antigonish, August, 1884. It has since been observed in the lakes and streams of Halifax County.



HETEROMEYNIA PICTOVENSIS, Potts.

A.—Skeleton spicules.

B.—Long birotulate.

C.—Short birotulate.

Genus IV.—Tubella.

Statoblast spicules with a rotule on one end only of the shaft, or inequirotulate.

9. *T. Pennsylvannica*, Potts.

Thin encrusting; rotule a very small circular entire disc, with the short central shaft attached on one side. Rare. Found in two lakes in the East River basin.

Note.—During the Summer 1885, the author extended the known range of the most of these species to the lakes of Halifax County, Nova Scotia, and to the lakes of the Island of Newfoundland.

APPENDIX I.

REPORT OF M. MURPHY, C. E., DELEGATE TO THE R. SOCIETY OF CANADA, MAY, 1883.

I HAD the honor, as delegate, to represent the Nova Scotia Institute of Natural Science, at the last annual meeting of the Royal Society of Canada.

At this first annual meeting of the N. S. I. of Natural Science for the session, 1884-5, it is, I presume, expected that I should submit to you, Mr. President and gentlemen, a few cursory remarks on my visit.

I will say, in a few words, my visit to Ottawa was both pleasant and instructive. It was made pleasant by the members of the Royal Society, and instructive by the papers read and the remarks elicited in the discussions thereon.

A delegate from your Institute is treated with all the privileges of a member during the session, he is allowed and invited to enter into the discussion of subjects, so varied that a party wishing to discuss any one subject will be afforded ample opportunity to do so.

I submitted a short paper giving a brief sketch of the life of the I. N. S., Nova Scotia—its operations and exchanges, together with the last printed number of the TRANSACTIONS.

I have, on behalf of this Institute, as well as on my own behalf, to thank Dr. Lawson and Dr. MacGregor for the manner in which they so kindly treated me throughout my visit. These gentlemen seemed to pay special attention, and in all instances saw that your delegate was neither forgotten nor neglected.

"Our Glacial Problem." By Rev. D. Honeyman, D. C. L., F. R. S. C., Hon. F. S. Sc.

(Paper read before the American Institute of Mining Engineers, Halifax, Sept. 15, 1885.)

Abstract.

A considerable part of the Introduction contained matter published in the Transactions of the Institute of Natural Science from 1876 to 1884.

When observations were made at Rimouski, in 1883, it was considered that we had reached the "Ne plus ultra" in that direction. On my working chart I had extended my "Halifax *hypothetical* line," which passed to the east of Rimouski, to the northern extremity,—lat. 52 deg., 50 min.; long. 75 deg., 45 min.

The reports of the Hudson Bay expedition of 1884, by Lieut. Gordon, R. N., commander, and Dr. Bell, geologist, with illustrative charts, blue books, and reports of progress of Geological Survey of Canada, have furnished us with important observations by which we are enabled to extend our investigations to existing glacial regions. Seven stations are reported as having glaciation with a south easterly course. Two of these,—viz. Marble Island, in the N. W. of Hudson Bay, and Nottingham Island, at the mouth of Fox's Channel—having, respectively, S. 20 E., and S. 30 E., (magnetic) courses attracted attention from their resemblance to leading Nova Scotia courses. This led me to extend my working chart so as to include these and the other five stations in Hudson Strait and the Atlantic coast. My chart, which was used in the illustration of this paper was thus six times the size of Lieut. Gordon's chart, being 9x6 feet.

Extending my Halifax and Rimouski, *Hypothetical* line, which was S. 20 E., N. 20 W., magnetic, it runs through Hudson's Bay, east of Marble Island, and west of Nottingham Island. I also extended my Antigonish and George's Bay *hypothetical* line.—(*Vide* Trans. 1883, page 35.) This also runs S. 20 E., N.

20 W., mag., at a distance of *three* degrees from the Halifax line. It, too, passes into Hudson Bay, east of Marble Island, and west of Nottingham Island. It was remarked that these two parallels included similar and different, even opposite courses, the agencies *not* proceeding to any great distance in straight lines, and often having their courses changed by obstructing causes. e. g. On the east side of Halifax harbor we have S. 5 E. lines, and between the *Hypothetical* lines to the east of Rimouski a line S. E. (Logan's Tables—Geology of Canada, 1863.) The harbours or fjords were seen to run approximately with the parallels, or the changed courses. (*Vide* Admiralty Charts.)

Lines of Equal Variation (Evans.)

I would observe that the *line of equal variation*, 20°, (*Vide* Sir Frederick Evans, Manual of the Variation of the Compass in Iron Ships, Plate VI., 1870, and Encyclopedia Britannica, Art. Meteorology, *Fig.* 30, Ninth Ed., Vol. 16, 1883) *runs between* these parallels from Nova Scotia to Hudson Bay.

Examining Sir F. Evans' Chart, Fig. 30, Enc., Brit., the line of equal variation, 20° in its southerly course, is seen to intersect the corresponding line, 20°, which runs through Great Britain at about lat. 17° N., and long. 23° W. In my Paper "On Glacial Action at Rimouski, Canada, and Loch Eck, Argyleshire, Scotland," Trans. 1883-4, I incidentally connected glacially what Evans connects magnetically.

I would remark, however, that "Marble Island" seems to be in lines of equal variation, 15°. This is west line 20°. Nottingham Island seems to be between lines 55° and 50°, the equal variation lines that run along Hudson's Strait from the Atlantic. This is the course of Dr. Bell's "Hudson's Strait Glacier. (*Vide* Report.)

Line of *no Variation.* (Evans.)

Having defined this on our chart, we find that it lies to the west of all the Hudson Bay Stations, having S. E. glaciation. It also lies to the west of all the leading S. E. lines of Sir W. E. Logan's Tables. In fact it passes *between* the S. E. and S. W.

lines as found at Lake Superior. We have thus the principal S. E. lines to the east of the line of no variation, and the S. W. to the west of it. On our chart the S. E. lines of Lake Temiscamang and Ottawa, and the S. W. lines of Lake Superior, have something of the aspect of an anticlinal, while the intermediate S. E. and S. W. lines are very much intermixed or confused. In my Paper, Trans. 1882, page 38, I remarked that the region of "glacial divergence seems to be also that of water." We have thus the apparently singular conjunction of magnetic, glacial and water divergence. Dana refers to the two last in Text Book of Geology. Third Ed.

The significance of this phenomenon we do not understand. It surely cannot be accidental. "Our Problem" must rest here.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. VI. PART IV.

Provincial Museum, Oct, 21, 1885.

ANNIVERSARY MEETING.

JOHN SOMERS, M. D., *Vice-President, in the chair.*

Since last Anniversary the Institute has had to mourn over the loss of their much esteemed PRESIDENT, ROBERT MORROW, ESQ, F. R. M. S., &c.

The CHAIRMAN read an address which was regarded as very interesting. A vote of thanks passed unanimously.

The TREASURER'S Account Book and Vouchers were presented, audited and found correct.

A. H. MCKAY, Principal of the Pictou Academy, Associate Member, was admitted an Ordinary Member, in accordance with Law 14.

The following were elected Office-Bearers and Members of Council for the current year:

President—JOHN SOMERS, M. D.

Vice-Presidents—WILLIAM GOSSIP, J. G. MACGREGOR, D. Sc.

Secretaries—REV. D. HONEYMAN, D. C. L., and SIMON D. MACDONALD.

Treasurer— W. C. SILVER.

Librarian—A. J. DENTON.

Council—AUGUSTUS ALLISON, MAYNARD BOWMAN, GEORGE LAWSON, PH. D., LL. D., EDWIN GILPIN, A. M., MARTIN MURPHY, C. E., A. H. MCKAY, B. A., B. SC., JOHN J. FOX.

ORDINARY MEETING, Provincial Museum, Nov. 9, 1885.

DR. SOMERS, *President in the Chair.*

Inter alia.

REV. ROBERT LAING was proposed a member.

A Paper was read by DR. HONEYMAN, "Additional notes on Glacial Action at Bedford Basin, Halifax Harbour and North West Arm."

DR. SOMERS read a paper, "On New and Rare Plants."

ORDINARY MEETING, Provincial Museum, Jan'y., 11, 1886.

DR. SOMERS, *President, in the Chair.*

Inter alia.

Reported that REV. ROBERT LAING had been duly elected by the Council.

DR. MACGREGOR read a paper, "On the relative bulk of certain aqueus solutions and their constituent water."

SIMON D. MACDONALD, F. G. S., read a paper "On Sable Island, its probable origin and submergence."

ORDINARY MEETING, Provincial Museum, March 8, 1886.

J. J. FOX, ESQ., *was called to the Chair.*

Inter alia.

PROF. LAWSON read and commented on a Collection of Plants, collected in the vicinity of Truro last summer, by G. G. CAMPBELL, B. Sc.

DR. SOMERS read a paper "On Nova Scotian Fungi."

An interesting collection of specimens from a battle-field in British Columbia, contributed to the Museum by H. R. REYNOLDS, was exhibited and examined. The collection consisted of portions of human skulls and teeth, with stone arrow heads and stone chisel. A vote of thanks was passed to the donor for his interesting communication which the specimens illustrated.

ORDINARY MEETING, Provincial Museum, April 12, 1886.

DR. SOMERS, *President, in the Chair.*

Inter alia.

A letter from the Hon. Secretary of the Royal Society of Canada, in reference to the appointment of a delegate, was submitted and referred to the Council. At the same time it was agreed to take up the matter at next ordinary meeting.

E. GILPIN then read a paper "On the Carboniferous Formation of Cape Breton."

DR. HONEYMAN also read a paper, "Notes of a Polariscopic Examination of Crystalline Rocks of Antigonish County."

ORDINARY MEETING, Provincial Museum, May 10, 1886.

DR. SOMERS, PRESIDENT, *in the Chair.*

Inter alia.

A. H. MCKAY was elected delegate to the Royal Society of Canada, and MAYNARD BOWMAN, alternate

J. J. FOX, ESQ., read a paper, "Observations on the Currents of the Gulf of St Lawrence"

DR. SOMERS also read a paper, "Notes on Delphinus delphis."

DR. HONEYMAN read a "Revision of the Geology of Antigonish County"

ANDREW DOWNS, M. Z. S., read a paper, "Ornithological Notes."

DR. HONEYMAN read "Notes on New and Rare Fishes."

LIST OF MEMBERS.

Dates of Admission:

1873. Jan. 11. Akins, T. B., D.C.L.
69. Feb. 15. Allison, Augustus, *Meteorologist*, Halifax.
77. Dec. 19. Bayne, Herbert E., Ph. D., F.R.S.C., *Prof. of Chemistry, Royal Military College*, Kingston, Ontario.
84. Mar. 13. Bowman, Maynard, *Public Analyst*, Halifax.
64. Dec. —. Brown, C. E., Halifax.
84. Nov. 1. Campbell, G. M., B. A., *Tutor in Mathematics*, Dalhousie College.
65. Oct. 26. DeWolfe, James R., M.D., L.R.C.S.E., Halifax.
84. April 13. Denton, A. J., High School, Halifax.
82. May 8. Fox, John J., Halifax.
73. April 11. Gilpin, Edwin, F.R S.C., F.G.S., *Govt. Inspector of Mines.*
63. Jan. 5. Gilpin, J. Bernard, M.D., M.R.C.S., Lond., F.R.S.C.
65. Feb. 5 Gossip, William, *Vice-President*, Halifax.
63. Feb. 5. Downs, Andrew, M. Z. S., Lond., *Taxidermist*, Halifax.
83. Mar. 12. Forbes, John, Starr Manufacturing Co'y, Dartmouth.
83. Mar. 12. Foster, James G., Barrister, Dartmouth.
81. Dec. 12. Hare, Alfred, Bedford.
82. April 12. Harrington, D., M.D., Halifax.
67. Dec. 3. Honeyman, Rev. D., D.C.L., F.R.S.C., F.S.Sc., Lond., *Secretary, Curator of Provincial Museum*, Halifax.
74. Dec. 10. Jack, Peter, Cashier of People's Bank, Halifax.
60. Jan. 5. Jones, J. M., F.R.S.C., F.L.S., Halifax.
82. April 10. Keating, C.E., City Engineer, Halifax.
85. Jan. 11. Laing, Rev. Robert, Halifax.
64. Mar. 7. Lawson, George, Ph. D. L.L.D., *Prof. of Chemistry and Mineralogy, Dalhousie College*, Halifax.
81. Mar. 14. Macdonald, Simon D., F.G.S., *Secretary.*
77. Jan. 10. Macgregor, J. G., D. Sc., F.R.S.E, F.R.S.C., *Vice-President, Prof. of Physics, Dalhousie College*, Halifax.
72. Feb. 5. McKay, Alex., *Supervisor of Halifax Public Schools.*
85. Oct. 21. McKay, A. H., B.A., B.Sc., F.S.Sc., Lond., Principal of Pictou Academy.
78. Nov. 1. McLeod, John, Demerara, West Indies.
70. Jan. 15. Murphy, Martin, C.E, *Provincial Engineer*, Halifax.

Date of Admission:

65. Aug. 19. Nova Scotia, the Rt. Rev. Hibbert Binney, Lord Bishop of
79. Nov. 11. Poole, H. S., Assoc. R. Sch. of Mines, Gen. Supt. of Pictou Coal Mines.
65. Jan. 8. Rutherford, Jas., Albion Mines, Pictou.
64. May 7. Silver, W. C., *Treasurer*, Halifax.
75. Jan. 11. Somers, John, M. D., F. R. M. S., *President*, Halifax.
85. Jan. 12. Stewart, John, M. D., Pictou.

ASSOCIATE MEMBERS.

82. Oct. 1. Gunn, John G. *Inspector of chools*, Cape Breton.
81. Nov. 13. Harris, C. *Prof. of Civil Engineering, Royal Military College*, Kingston, Ontario.
76. Nov. 9. Kennedy, Prof., King's College, Windsor.
82. Mar. 31. McKenzie, W. B., Engineer, Moncton, N. B.
83. Mar. 12. McKenzie, C. H., M. D., *Inspector of Schools*, Parrsboro.
78. Mar. 12. Patterson, Rev. G., D. D., New Glasgow.
84. April 4. Pines, A. J., Wolfville.

CORRESPONDING MEMBERS.

71. Nov. 29. Ball, Rev. E., Tangier.
71. Oct. 12. Marcou, Jules, Cambridge. Mass.
80. June 10. McClintock, Sir Leopold, Knt., F. R. S., Vice-Admiral.
77. May 12. Weston, Thomas C., Geological Survey of Canada.

LIFE MEMBER.

Parker, Hon. Dr., M. L. C., Halifax.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—ADDITIONAL NOTES ON GLACIAL ACTION IN HALIFAX HARBOUR, NORTH-WEST ARM, AND BEDFORD BASIN. — BY REV. DR. HONEYMAN, D. C. L., F. R. S. C., F. S. SC., &c.

(Read November 9, 1885.)

EXAMINATION in detail reveals many interesting and important points that have not been noticed in preceding papers. To some of these I now propose to direct attention.

BEDFORD BASIN.

Having now resided a year and a half about half way up Bedford Basin, I have had favourable opportunities for studying the geology of this beautiful and picturesque region. Again and again I have referred to Navy Island, on the east side of the Basin, as having a glacial deposit of the "Cow Bay Type," replete with triassic and archaean boulders. To the north and south of this, from Bedford to the Narrows, expanses of drift have been examined of similar constitution.

The greatest breadth as well as depth of the Basin is between the Navy Island side and Birch Cove. The breadth here is two miles, and one of the Admiralty soundings, about midway, is 84 fathoms—(*Vide* Chart). As might be expected, its marine zoology is very interesting. This year its mackerel fishery has been very productive, and many singular fishes, especially *scomberesox saurus*, have been found in its waters.

The mollusca of Halifax harbor are decidedly Arctic and Boreal.—(*Vide* below.)

The Intercolonial Railway traverses its western side and south as far as the Narrows and Richmond. On its south side a branch line from Richmond extends to the cotton factory. This passes below Rockhead—the city prison. The cotton factory siding runs up a hollow to the west of Rockhead. Through this passes the short roads from Bedford to Halifax. Still further west is a deeper hollow. Through this passes the road to Dutch Village. It connects also the Bedford Basin with the North-West Arm. South of Rockhead, lies Fort Needham. I indicate these as they are connected with our investigations.

Along the west and south sides of the Basin are large accumulations of drift. On the west these are well exposed in roads and railway sections. They consist of rock masses, large and small stones in great abundance. There are quartzites imbedded generally in quartzite debris which is used for road material. I have searched diligently in this drift for triassic and archaean boulders, such as those found on Navy Island, without success. I have been equally unsuccessful in finding such boulders in the drift in the road cuttings towards Halifax and Dutch Village.

On the south side of the Basin I examined the sections on the shore, and also on the railway and cotton factory branch, without success.

Great caution had to be exercised in this investigation from the circumstance, that we have here railway *versus* glacial transportation. A great proportion of the railway ballast was brought from Truro, from the banks of glacial drift, through which the Intercolonial railway passes. This drift is largely derived fram Archæan rocks of the Cobequid Mountains. Out of this ballast stray boulders of syenites, gneisses, diorites, etc., are found on the shore and at the bottom of the drift cuttings. We have therefore to observe well, and reject all boulders that are not in the undisturbed drift.

We consider that all the drift under examination is either of local origin or at the farthest can only have come from a distance of 20 miles, the north side of the Cambrian quartzite band of rocks, while that on the opposite side of the Basin was derived from the geological formation of the Cobequids and all the intervening formations.—(*Vide* Geological Map and Papers read before the Institute.)

Lumber Yard.

I would add to the accumulations of the "Cow Bay type" an elevation in the Lumber Yard. On this are the remains of one of the "old forts."

Connecting Lines.

A passes from Navy Island along the east side of the Basin to the Narrows, near Dartmouth Railway Bridge. It then crosses over to Richmond to Fort Needham. Proceeding it reaches the Queen's Dock Yard, at the late Observatory Hill. It then extends to the east side of the Citadel Hill. Thence it goes to the Lumber Yard, and then it passes to the Fort at the east side of entrance to the N. W. Arm.

B begins at the west side of George's Island, which lies in the harbour opposite the Lumber Yard. Thence it goes southerly to the west side of Cornwallis Island (McNab's). Proceeding along this Island it connects Thrum Cap and Shoal.

C may commence at the drift at the corner of Preston and Lawrencetown roads. Thence it passes to the accumulation at the top of Dartmouth Cove It then extends along the shore to the neighbourhood of Fort Clarence at the Eastern Passage.

D may be called the Terminal Line. This may begin at the accumulation at the old fort (of *A* line), and pass across the mouth of harbour to Thrum Cap. Thence it proceeds N. E. to the eastern side of the Passage. It then extends along the shore, to Cow Bay and Osborne Point. From this it extends to Lawrencetown Head; from this to Half Island, and then to Three Fathom Harbour.

The Triassic Amygdaloids from Blomidon and Partridge Island which I regard as the prime characteristic of the drift of the accumulation, etc., which I have thus connected, have their extreme easterly points of occurrence at—

1. Three Fathom Harbour, on the Atlantic Coast.
2. Preston.
3. Goff's, on Old Guysboro' Road, or rather ½ mile beyond
4. Enfield, on the Intercolonial Railway. *Trans.* I. N. S.

E. Connecting these points we have a line which may be regarded as the eastern boundary of Amygdaloidal drift distribution, while A line may be regarded as the western boundary. We may thus have the approximate form and width of the moraine of which the accumulations formed a part. The width from N. W. Arm to Three Fathom Harbour is about 16 miles, from Navy Island to Preston it is 9 miles. Enfield is 23 miles nearer Blomidon and Partridge Island than Three Fathom Harbour.

Col. Akers directed my attention to a scooped out ledge on the site of the Old Chain Battery at the North-West Arm. I have pointed out the *roche moutonnee*, containing what is supposed to be a relic of the Chain Battery, with a scooping of argillites, on the entrance to the road that leads to the Prince of Wales Tower.

These indicate the scooping power of the agency which seems at least to have aided in the formation of the North-West Arm. At the top of the Arm, on its western side, I also shewed another scooping, when I was engaged making observations on the glaciation of the Halifax Peninsula.

Breccia.

It is upwards of 20 years since my attention was directed to a formation of this kind overlying the tilted argillites. This conglomerate was observed at the east side of the North-West Arm, at its top, and also on the west side of the Harbour between Richmond and H. M. Dockyard. Considering this to be like other conglomerates, formed by the action of sea agency, I was disposed to regard our conglomerate as the remains of an ancient formation, *e. g.*, Carboniferous. Good examples of this may be seen at the west side of the North Street I. C. R. Station and opposite the late Observatory Hill, and at the north-end of Dutch Village. I am persuaded that the rock is a glacial debris cemented together by the oxide of iron derived from the pyrite of the argillites which chiefly constitute the Breccia. Sections indicated the Breccia filling the hollows of the underlying argillites.

Purcell's Cove.

Here we have an island at its entrance which has a very ferruginous aspect. To all appearances it is composed of debris. Its position near the entrance to the N. West Arm, suggests its origin. It seems to have been formed from the scooped material of the N. West Arm. Masses detached show that it is largely conglomerate cemented with oxide of Iron.

These show that glacial agency may also form conglomerates, and Breccias as well as marine agencies which have been chiefly employed in this work.

In my Paper, Session 1886-7, I gave a list of characteristic boulders of the "Amygdaloidal Drift" exhibited at the Centennial Exhibition, Philadelphia. I would now give the same with subsequent additions.

Archæan.

1. Granites.
   — hornblendic.
   Syenites.
   Diorites.
   — magnetitic.
   Gneisses.
   — magnetitic.
   Porphyrites.

Silurian.

2. Quartzite, olive-coloured with crinoids.

Carboniferous.

3. Limestones.
   Bituminous.
   Fossiliferous *(fauna)* Brachiopoda, &c.
   Sandstones (yellow.)

Flora.

Stigmaria.
Lepidodendron.
Calamites.

TRIASSIC.

Basalts.	Blomidon or Parrsboro.
" with olivine,	" "

Amygdaloids, with Heulandite, Stilbites, Chalcedony, &c.
Agates.
Jaspers.

GLACIAL HIGHWAY.

We propose now to go northward in the direction of our main glacial line, N. 40° W., to notice its Geology and to indicate the formations that have produced the drift material already referred to. From Halifax Harbour Mouth, a distance of 33 miles, (Mackinlays' Map) we have the Lower Cambrian Formation with its Quartzites and Argillites and associated Granites, west side of the Harbour and Mount Uniacke. On our way we have passed through the County of Halifax and entered the County of Hants. We now enter the Carboniferous Formation with its Sandstones, Limestones and Gypsums. The Limestones are sometimes fossiliferous (Fauna) the Sandstones, &c., having Flora. Passing through these 21 miles we reach the "Mines Basin," Reaching the other side we have gone 18 miles. The Formation lying under the water is the Triassic. (New Red Sandstone.) At 12 miles distance we passed Blomidon with its Basalts and Amygdaloids and Sandstones. On the north side of the Basin we have Partridge Island similarly constituted. We are now in Cumberland County at the junction of the Triassic with the Carboniferous Formation. Proceeding through Parrsboro' we traverse its Carboniferous to a distance of 4 miles. We have reached the Cobequid Mountains with (a) its Upper Silurian Formation (metamorphic.) This is the band that contains the Londonderry Iron Mines, about 40 miles to the eastward. After going ten miles and a half we reach Crystalline, Metamorphic, rocks of Archæan or Pre-Cambrian age, with Granites, Syenites, Gneisses, &c. About 5 miles of these bring us to the Carboniferous, without any other Formation intervening. We are now in the Cumberland Coal Field, with Springhill Mines and the South Joggins, celebrated in geology on account of its marvellous shore section. *Vide* Dawson's Acadian Geology, Lyell's Elements, Dana's Manual, &c.

We have thus crossed Nova Scotia from Halifax Harbour to the Chiegnecto Channel, which separates it from New Brunswick.

Sequence of Formations.

Lower Cambrian with Granites, Carboniferous, Triassic, with igneous rocks, Carboniferous, Silurian, Archæan, Carboniferous.

I have referred to the Mollusca of Halifax Harbour and Bedford Basin.

From Catalogue of J. M. Jones, F. L. S. Trans. 1877.

CLASS CONCHIFERA.

Fam. Solenidæ.

1. Solenomya borealis, Tott. Halifax harbour. (Verrill.)
2. Panopœa arctica, Gould. Halifax harbour.

Fam. Myadæ.

3. Mya truncata, L. Halifax harbour.

Fam. Anatinidæ.

4. Lyonsia arenosa, Morch. Halifax harbour.
5. Thracia myopsis, Beck. Halifax harbour. (Smith and Harger.)

Fam. Gastrochænidæ.

6. Saxicava arctica, Desh. Museum. Halifax harbour.

Fam. Tellinidæ.

7. Macoma fusca, Gould. Halifax harbour.
8. M. sabulosa, Morch. Halifax harbour. (Smith and Harger.)

Fam. CYPRINIDÆ.

9. Astarte castanea, Say. Halifax harbour. (Willis.)
10. A. crebricostata, Forbes and Hanley. Halifax harbour.
11. A. sulcata, Flem. Halifax harbour.
12. A. semisulcata, Gray. Halifax harbour.
13. Cyprina Islandica. Halifax harbour.

Fam. VENERIDÆ.

14. Callista convexa. Halifax harbour. (Willis.)

Fam. CARDIADÆ.

15. Cardium Islandicum. Halifax harbour.
16. Serripes Grönlandicus, Beck. Halifax harbour. (Willis.)

Fam. ARCADÆ.

17. Yoldia obesa. Halifax harbour.
18. Y. thraciæformis. Halifax harbour.
19. Y. sapotilla. Halifax harbour.
20. Leda tenuisulcata. Halifax harbour.
21. L. minuta, Mol. Halifax harbour.
22. L. caudata, Loven.

Fam. MYTILIDÆ.

23. Modiolaria nigra, Loven. Halifax harbour.
24. M. discors, Beck. Halifax harbour.
25. M. corrugata, Morch. Halifax harbour.
26. Crenella glandula. Halifax harbour.

Fam. OSTRÆIDÆ.

27. Anomia glabra, Verrill. Halifax harbour.

CLASS BRACHIOPODA.

Fam. TEREBRATULIDÆ.

28. Terebratulina septentrionalis, Couth. Halifax harbour.

Fam. RHYNCONELLIDÆ.

29. Rhynconella psittacea, Owen. Halifax harbour.

CLASS GASTEROPODA.

Fam. TRITONIDÆ.

30. Dendronotus arborescens, Ald. and Han. Halifax harbour.
31. Eolis nana ? Ald. and Han. Halifax harbour. (Verrill.)

Fam. TROCHIDÆ.

32. Margarita helicina, St. Halifax harbour.

Fam. SCALARIDÆ.

33. Scalaria grœnlandica, Sow. Halifax harbour.

Fam. TURRITELLIDÆ.

34. Turritella reticulata. Halifax harbour.
35. T. acicula, St. Halifax harbour.

Fam. CERITHIDÆ.

36. Apporhais occidentalis. Halifax harbour.

Fam. VELUTINIDÆ.

37. Velutina zonata, Gd. Halifax harbour.

Fam. NATICIDÆ.

37[a]. Lunatia groenlandica.
38. Natica clausa. Halifax harbour.

Fam. PURPURIDÆ.

39. Buccinum undatum.
40. Neptunea decemcostatus. Halifax harbour.

Fam. CANCELLARIDÆ.

41. Trichotropis borealis, Sow. Halifax harbour.

In this list of 42 we have 12 arctic and 30 boreal. In Woodworth's Distribution Chart, *vide Manual of Mollusca*, Nova Scotia is included in the "Boreal Region."

These zoological observations are suggestive of certain geological and palæntological investigations which I reported to the Institute in my Paper read Nov. 9, 1874, "A Month among the Geological Formations of New Brunswick." Trans. Vol. IV, Page 19 *Extract.*

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 glacial drift is evident from the great coarseness of the material, the massiveness of the enclosed boulders, the want of stratification and the absence of marine relics (fossils.)

I also noticed the first cutting across the Teteagauche.

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,"

At Jacquet River were found cuttings in the Intercolonial Railway, having the same fossils as at Teteagauche. Here was found embedded a skeleton of a Beluga. The greater part of this is in the Provincial Museum. It was described by Dr. Gilpin in a paper communicated to the Institute. Trans. vol. iii. page 400.

At the Fisheries Exhibition of London, 1883, I exhibited characteristic portions of this skeleton with associated shells. This was considered as interesting in connection with the exhibition of the white whale (Beluga) from River St. Lawrence. The two exhibits showed that the Beluga frequented this river from the Champlain period to the present time.

Our observations on the Mollusca of Halifax Harbour seem to show that the mollusca of the present period of Halifax are essentially the same as the Postpliocene *Mollusca* of the northern part of New Brunswick, and also of eastern Canada.

The glacial drift of the I.C.R. and the Teteagauche and Jacquet river beds at Nepisiguit River, lies between our two glacial parallels—Chart of Glacial Problem—or in an intermediate parallel drawn from Beaver Harbour, which lies 58 miles east of Halifax Harbour.

ART. II. — ON THE RELATIVE BULK OF CERTAIN AQUEOUS SOLUTIONS AND THEIR CONSTITUENT WATER.— BY PROF. J. G. MACGREGOR, D. SC.

(*Read January* 11, 1886)

THE following experiments were made with the object of determining whether or not weak solutions of Sodium Phosphate and Carbonate have volumes which are less than the volumes at the same temperature of the water which they contain.

Professor Ewing[1] and I had found that sufficiently weak solutions of sulphate of copper contain amounts of water whose volumes if free would be greater than those of the solutions themselves; and that anhydrous copper sulphate, added in small quantities to water, produces solutions of smaller bulk than the original water. It seemed desirable therefore to extend the investigation to other hydrated salts.

The apparatus employed consisted of dilatometers, which were large glass bottles (commonly called Winchester quarts), with glass tubes fitted in their necks. The bottles had capacities of about 2,600 c.c. The glass tubes were about 25 cm. in length and 0·4 sq. cm. in section, and were chosen so as to be as uniform in bore as possible. They were fitted to the bottles by means of India-rubber stoppers, and fitted so tightly that there could be no danger of any relative displacement of tube and bottle. The rubber stoppers were held fast to the bottle by wires. Their inner ends were hollowed conically, and the glass tubes started from the summits of the conical hollows, so that air bubbles could easily be made to pass up the tubes. At their upper ends the tubes widened into funnels. Fine scratches on the tubes served as zero marks. The bottles stood in a large zinc bath up to their necks in water. The dilatometers were calibrated by

[1] Trans. Roy. Soc. Edin., vol. xxvii. (1873) p. 51; Reports Brit. Asso. (1877); Trans. Roy. Soc. Canada, vol. ii. (1884) sec. iii., p. 69.

being filled with distilled water of known temperature, from measuring vessels whose volumes were known. The one used in calibrating the tubes was so divided that changes in the volume of the water it contained could be read to 0·05 c.c. The water, with which the bottles were thus filled, had been freed from air under the receiver of an air-pump.

To test the tightness of the stoppers, the dilatometers were filled, until the upper surfaces of the water were near the tops of the tubes. The stoppers were thus subjected to as great pressures as they would be during the experiments. After the bottles had taken the temperature of the bath, I observed the variation of the height of the water in the tubes from time to time, until I had satisfied myself that there was no leak,—a return to a formerly observed height in one bottle being accompanied in all cases by a similar return in the others.

I next satisfied myself that differences of temperature between the bottles, greater than any which could arise during the experiments through the dissolving of salt in some bottles and not in others, would vanish in less than the time that was to intervene between successive measurements.

As the dilatometers could not be kept at constant temperature, and as any change of volume of their contents must therefore be partially due to change of temperature, it was necessary to know the relative apparent thermal expansion of their contents. For this purpose, both at the outset when all the bottles contained water, and at intervals during the series of experiments when some of them contained solutions, the temperature of the bath was varied, and the heights of the water or solutions in the different tubes were observed when the bottles had assumed the temperature of the bath. These results were tabulated for purposes of correction.

The solutions, whose volumes were measured, were formed by the addition of known masses of anhydrous salt to the water in the bottles. The salt was simply dropped little by little down the tubes of the dilatometers. Occasionally the salt was found to cake at the surface of the liquid. In that case various expedients were adopted to hasten the solution; but the greatest care was taken to prevent the loss, either of any of the salt which had been weighed out for solution, or of any of the liquid in the bottles. When the desired amount of salt had been added to a bottle, the upper end of the tube was closed with a small cork to prevent evaporation, and the bottle was put in the bath. After an interval of about twenty-two hours the bottle was taken out, and, if the salt was found to be dissolved, was first well corked, and then rolled, until its contents had been thoroughly mixed. It was then replaced in the bath and left for another hour, when the height of the free surface of the liquid was observed. Not possessing a cathetometer, I required, for measuring differences of level, to trust to a steel scale placed in contact with the tube. Care was of course taken to avoid parallactic errors as much as possible.

To one of the bottles no salt was added; and it was kept carefully corked up, so that the quantity of water it contained might be constant. The variation of the height of the water in the tube of this bottle was due, of course, to change of temperature alone. This variation being observed, and the relative apparent thermal expansions of the liquids in the four bottles being known from the subsidiary experiments referred to above, the variations due to changes of temperature, of the heights of the solutions in the tubes of their respective bottles could be determined and eliminated. The variations of temperature were in all cases slight, the bath being large and its daily thermal history being very constant.

The salts used, the acid phosphate of Sodium ($H_2\,Na\,PO_4 + 12\,H_2\,O$) and the basic carbonate of Sodium ($Na_2\,CO_3 + 10\,H_2\,O$) were bought as pure, repurified by crystallization, and dehydrated by careful heating to the necessary temperature.

In all cases, after the solutions had stood awhile, a slight fluffy appearance presented itself in the bottles. The mass of the precipitated solid was, however, very small—so small that it was hardly possible to weigh it. Hence I considered that its effect on the result might be neglected. It was probably due to the presence of some impurity in the water.

In both cases I found weak solutions of these salts to have smaller volumes than their constituent water would in the free state possess. In the case of the phosphate, this is true of all solutions containing less than about 0.016 per cent. of the anhydrous salt, the difference of volume being greatest in solutions containing about 0.011 per cent. A solution of this strength, containing 1000 cubic inches of water, has a volume of 999.87 cubic inches. In the case of the carbonate I found the greatest difference of volume to occur with a solution containing about 0.026 per cent. of anhydrous salt, a solution of this strength which contained 1000 cubic inches of water having a volume of 998.27 cubic inches.

Art. III.—Sable Island, No. 3.—Its Probable Origin and Submergence.—By Simon D. Macdonald, F. G. S.

(*Read January* 11, 1886.)

Mr. President and Gentlemen,—

I make no apology for occupying your attention in discussing for the third time Sable Island, and its attendant phenomena.

Independent of the call this Island makes to a rich and varied field for scientific research, there comes a deeper voice across the mad tumult of its breakers, and amid the storms that appear to vent their fury in its vicinity, asking in the interests of humanity for a wider knowledge of the causes which have associated such horrors with its very name.

In addition to this, the proximity of this fatal Island to our shore,—the unfavorable reputation it has already given to our coast and its approaches, and the certainty of its complete submergence at no distant day, with the probability of its becoming a still greater dread to the mariner,—makes this Island a proper subject of investigation for this Society.

It comes within its province to observe and record for the benefit of not only the present but for the many future investigators, who will doubtless value everything of information left by us, and scan with eager glance in coming days the varied resume of facts we have collected, or left for them to theorize and debate upon.

In my first paper I brought to your notice the Island generally, its history, natural features, wrecks, etc.; and also showed that from its geographical position situated at the interlacing of three of the most remarkable currents which encircle it with those swift eddies so fraught with destruction, whilst the atmospheric influences borne to it on the bosom of those dissimilar and opposing currents, surround it with conditions not found elsewhere, and afford for meteorological purposes a point unsurpassed in the North Atlantic.

In my second paper I called your attention to the vicissitudes this island had undergone from storm and current which, according to Admiralty surveys, had within 80 years reduced its area from 40 miles in length and $2\frac{1}{4}$ miles in breadth to 22 miles in length and less than 1 mile in breadth, and its height from 200 feet to 80 feet, materially altering its outline and position.

I will now endeavor to trace its origin, its relation to that vast sand accumulation known as off shore banks, and also the causes now at work hastening its destruction or submergence.

Of course any attempt at an explanation of its origin must be based upon the assumption that it is the result of natural agencies, in other words that it is not a mere huge sand bank thrown up by some freak of nature, as it might appear to a casual observer, but that the forces that rolled each grain of sand against its fellow until this immense accumulation arose as an island from its ocean bed, are governed by a law as fixed and unalterable as that which holds the planets in their orbits.

In seeking for its origin among others two theories are prominent. 1st, that it is the result of causes now visible and subject to investigation, as in the case of material being transported by icebergs. 2nd, that it is the remains of a former age, now undergoing geological changes yet unfinished.

Before us we have a chart showing off shore banks, and another showing their relative submergence, which I have compiled from latest surveys.

Beginning at the eastern extremity of this remarkable formation we have what is known as the great bank, 240 miles E. and W., and 294 miles N. and S., an area equal to the whole island of Newfoundland. West from this we have the Quero bank, 120 miles in length; north of this again is the Canso bank, 60 miles in length; west from Quero, 12 miles distant, we have the Sable Island bank, 200 miles in length and 90 miles in breadth. On this bank we have a narrow thread-like elevation above the surface which is Sable Island proper. North of this, separated by a narrow channel, is what is known as the middle ground, 35 miles in length. West from this is Sambro, 12 miles in length; then LaHave bank 32 miles E. and W.; then the Roseway bank, 16 miles long; westward again we have the Great George's bank, with shoals reaching the surface; a little further westward we reach the shoals of Nantucket; the whole forming an immense deposit, following the curvation of the coast.

We will now turn from geological formation to the course of those great currents which divide and control ocean forces.

By glancing at Maury's physical chart it will be seen that the Gulf Stream, after discharging its heated water through the channel formed by the coast of Florida on the one side and Cuba and the Bahamas on the other, follows the trend of the American coast northward until approaching the shoals of Nantucket where it swerves to the N. E., passing south of Sable Island to the tail of the great bank of Newfoundland, and then stretching over to Europe in a due east direction.

In opposition to this we have the cold ice-laden current of the north, one portion of which after leaving the Arctic ocean, passes southward along the eastern coast of Greenland where, being joined by another branch coming from Baffin's Bay and Davis Strait, it passes along the coasts of Labrador and Newfoundland to the great banks, where it is met by the northern edge of the Gulf Stream.

At this point a division of the polar current takes place. One portion, from its greater density, sinks below the warm current of the Gulf Stream, and continues its course southward as a submarine current.

The other portion of the polar current, where it impinges on the Gulf Stream at the Great bank, becomes deflected to the westward partially by contact with the Great bank, and in its course its northern edge sweeps around Cape Race into St. Mary's and the other bays north until losing its momentum it falls back and joins the main body of the current. This portion, sweeping around and into those bays, is commonly called the indraught by mariners, and to it being accelerated by certain storms may be attributed the loss of the Cedar Grove at Canso and the Cromwell boats and the Hanoverian at Cape Race.

The southern edge interlaces the Gulf Stream and carries western bound vessels at such a rate as frequently leads mariners to miscalculate their position with reference to this Island, to which fact is attributable many of the wrecks.

Capt. Darby, a former Superintendent of the Island, in a letter to Blunt's coast pilot, with regard to the strength of this polar current, says:

"The most of the wrecks occurring here arise from error in longitude. I have known vessels from Europe that had not made an error of half a degree in their longitude until they came to the banks of Newfoundland, and from there in moderate weather and light winds have made errors from 60 to 100 miles."

It is difficult to understand how that the commanders of vessels making voyages to and from this country for so many years, should be apparently so ignorant of the strength of these currents, unless as it would seem they have periods of comparative quiescence and activity.

Then again we have a third current, a portion of the polar current, which, becoming detached at the southern end of Labrador and sweeping through the Strait of Belle Isle, is joined by the vast flow of the St. Lawrence, and forms what is known as the Gulf of St. Lawrence current. This combined current skirts the east side of Cape Breton, passes south and strikes obliquely in the vicinity of Sable Island, that portion of the polar current which is deflected westward by contact with the Banks of Newfoundland.

We will refer to this oblique current again.—

From ocean currents we will consider another of nature's great forces shown in the transporting power of ice.

This great polar current skirting the coast of Greenland and Labrador is constantly bringing its great ice rafts laden with rock, sand and gravel from the north to the margin of the Great Bank, where meeting the warm waters of the Gulf Stream they deposit their burdens, the finer portion of which being carried forward by the current is distributed along the line of the impinging stream.

To learn something of this transporting power we will refer to the evidence of those Arctic navigators who have minutely chronicled their observations.

Capt. Scoresby, who reconnoitered the foot of the great glacier of Spitzbergen, counted at one time upwards of 500 icebergs starting out on their course southward, many of which were laden with thousands of tons of sand, mud and gravel.

Capt. Wilkes, of the United States exploring expedition, landed upon an upturned iceberg, supposing it to be an island. Upon it he found huge boulders of basalt and sandstone embedded in mud, sand and gravel, the whole forming an ice conglomerate.

Sir John Ross mentions an incident of an iceberg capsizing in lat. 74°, bringing up a portion of the bottom 100 feet above the surface, so that it was for the moment supposed to be an island not previously seen.

In addition to the masses of rock, sand, etc., accumulated on the surface of the glacier from the adjoining cliff, and the mud and sedimentary matter scooped from the sea bottom by upturned icebergs, is to be added the effect of land ice, as observed by Kane and others, where the shores of the Arctic in a similar manner to ground ice forms in more than a hundred feet of water, raising from the bottom an enormous amount of material. On the breaking up of the ice those floes are carried off by the current southward to be discharged at the great dumping grounds of Newfoundland.

Commander White, of the U. S. Navy, in his Arctic voyages also relates seeing the birth of an iceberg which cracked from the glacier with a loud report, and after a summersault in 180 fathoms of water appeared with an enormous cliff of granite embedded in its surface, which it had carried from the adjoining bluff.

It is obvious that with this transporting process, carried forward for a long period of time, we may look here for deposits on a colossal scale, and account for not only the great Bank of Newfoundland, but the whole series of Banks, of which Sable Island is the apex.

It may be thought by some that while this process may be deemed sufficient to account for the formation of the great Bank, we must look to some other source for the presence of the western Banks, Assuming this to be the force that created the great Bank, there must have been a time when this Bank had not reached its present dimensions, and indeed was only in the first stages of formation, consequently the unimpeded Gulf Stream would press the shore more closely, crowding the western bound currents and thus by narrowing its channel increase its velocity. Add to this the fact that the polar current, not being divided as now by the great Bank, would have a more decided flow, and would carry its ice raft further westward. Thus the dumping of material would take place at the western extremity as well as along the whole line of interlacing currents.

This opinion is strengthened by the fact of the walrus having once resorted to this Island in great numbers, their tusks being frequently found imbedded in the sand.

That icebergs once followed the line of the polar currents past our shores there can be no doubt, even in this period.

By referring to Blunt's coast pilot, where pointing out the ice dangers of the coast, we find the following:

"In July, 1836, H. M. brig packet Express fell in with two islands of ice on Sable Island bank, lat. 43.03, long. 25.17, in 45 fathoms of water, estimated height 150 and 180 feet."

I would next call your attention to the wonderful similarity of those Banks and their limited amount of submergence, which suggests that many of them, if not all, have been elevated above the surface at no distant period in the past. We will consider the most interesting ones.

By glancing at this chart of relative submergence of off shore Banks, at the eastern extremity, we have the great Bank of Newfoundland, at the summit of which is a very dangerous shoal known as the Jessie Ryder, having only $3\frac{1}{4}$ fathoms or $19\frac{1}{2}$ feet.

At Quero bank, in lat. 44, long. 57, is a long narrow submerged ridge 40 miles in length, which in form and direction is an exact counterpart of Sable Island.

Next is the Sable Island Bank, 200 miles by 90, with a thin line of elevation, already alluded to, of 80 feet above the surface.

The next is one of great interest, viz., George's shoals, situated at George's bank, off the New England coast.

Capt. Hale, of the U. S. Navy, who surveyed this Bank, reported "That the breakers were such that unless the weather was perfectly calm it was impossible to go among the shoals with boats on account of the heavy seas. Nor was it considered safe to attempt it with the vessel, for besides the danger of striking on a sand bar the vessel would be liable to be filled with the breakers. And had not the sea been perfectly smooth and at high water, he would not have been able to get where he found but 3 feet at low water. And further he had no doubt but that this patch would be bare with a continuance of off shore winds."

This spit has an area of about one-third of Sable Island.

The breakers on those shoals are very heavy and can be heard and seen for a considerable distance.

It may be argued that this theory may account for the formation of this island, but not for its elevation above the surface.

In my last paper I referred to one of the most remarkable features in connection with this place, viz., the swirl-like current that surrounds it. A good illustration of this was given when, in February, 1803, the first superintendent having had three months of anxiety from the rapidity with which the island had been washed away in the vicinity of his house, and having lost much of his provisions by the depredations of rats, and fearing that want would stare him in the face before relief would reach him in the spring vessel, built a dispatch boat and sent her out crowded with sail before a S. E. gale in hopes she would reach the main land or be picked up by some in bound vessel that would carry the dispatches to the government, and acquaint them of the condition of affairs on the Island.

To his surprise, in 13 days after she returned to the beach, 6 miles above where she set out from.

Experiments are often made to test the strength of this current by throwing over a cask or barrel which will make circuit after circuit of the Island.

Bodies from wrecks also make the same circuit. It is quite customary for the surfmen to search on the opposite side for things which, in consequence of off shore winds, have been carried thither by the current and deposited upon the beach.

This swirl is no doubt caused by this third current, viz., the Gulf of St. Lawrence, augmented by that portion of the polar that sweeps through the Straits of Belle Isle, striking obliquely the other portion of the current in the vicinity of the island.

It is a well established fact that oblique currents have a tendency to form eddy or circular currents, and also that eddy currents of water pile up material carried along with it, as eddies of wind carrying snow build up all manner of fantastic drift.

In like manner this eddy or swirl current passing over a shoal so near the surface heavily charged with sand, on meeting with an obstacle, or even in its own vortex, would deposit the material held in suspension, thus forming a nucleus of the island. This shoal once reaching the surface and coming within sub-aeriel influences would hasten land making.

A beach once formed, the surface exposed at low water, would be dried and carried by the wind to a greater height, little by little hillocks or sand dunes would form. The waves would push forward the material on a long reach of bank near the surface, gradually the current would be crowded off shore, but still assisting to increase the area by depositing its material, which in turn would be dried and carried upwards by the wind. At last vegetation appearing the roots would anchor the summit.

Thus the process of land making would go forward so long as currents were favorable.

We have a remarkable instance of this in the formation of what has been called the new island off the east-end light.

An old wreck formed the nucleus around which the current piled its material, until a shoal formed, which gradually reached the surface and formed a small island.

At length grass seeds borne from the main island took root, anchored its summit and hastened its up-building.

This little island forming was watched with great interest by the surfmen, who entertained the hopes of its attaining such dimensions as would afford slight shelter, if only for a moment, when passing in the life-boat to a wreck on the N. E. bar. But the current that eddied around it became changed or weakened; it being left to the attacks of wind and wave and perhaps an adverse current, melted away. A channel now marks the place it once occupied.

As in the case of this small island land building reached its culmination and declined. So in the case of the main island. Brought into existence by the current its maintenance would depend upon the favorable condition of the current.

But when the great Bank of Newfoundland reached such dimensions that it interrupted and divided the polar current, sending one portion southward, the other on its western way, as a reduced and sluggish stream, the effect becomes at once visible. All the western eddies or currents would be altered, the swirl that so aided in the formation of the island so weakened that during storms it would be converted into a confused erratic current, which, gnawing at the foot of the embankment, would topple great masses of its sand cliffs into the waves, as recorded from time to time by eye-witnesses. In this manner the forces that called this island into existence may now, under changed conditions, be hastening its destruction.

The first theory then is one supported by actual observation, and may be a prominent one in future investigations.

I now turn to the second theory, which has for its subject the result of those great forces exhibited during the ice age or glacial period.

That such a period did exist is beyond all controversy, although the condition of that period is still a matter of dispute among geologists.

I will epitomize two of the most popular theories: 1st, that of Lyell, Dawson and others, who suppose a general subsidence took place bringing down each part of the land successively to the level of the water.

Large islands and bergs of floating ice came from the north which, as they grounded on the coast or on shoals, pushed along all loose material of sand and gravel and broke off all angular and projecting points of rocks and where fragments of hard stone were frozen into the lower surface scooped out grooves into the sub-adjacent solid strata.

After the surface of the rocks had been smoothed and grated upon by the passage of innumerable icebergs, the clay, sand and gravel of the drift were deposited and occasionally the fragments of rock, both large and small, that had been frozen into the glacier or taken up by current ice, were strewn at random over the bottom of the ocean wherever they happened to be detached from the frozen ice.

Finally a period of re-elevation, or that intermittent upward movement in which the old coast lines were excavated and the ancient sand bars laid down.

This process continued for an unlimited period, which has been considered to be quite sufficient to account for all the phenomena observed.

The second theory is one advanced by Agassiz and adopted by a large majority of geologists who have interpreted the glacial period as being one in which those forces acted on a much grander scale, which has been so graphically described by Dana, Belt and others. As a time when from the then elevated frozen regions of the Arctic an enormous ice-cap or glacier estimated to be from 4,000 to 6,000 feet in depth was forging its way southward across the northern portion of this continent with terrible abrading power, scooping out valleys, wearing the softer rocks into clay, tearing asunder the harder crags, grinding and polishing and grooving the sub-adjacent rocks, pushing before it and incorporating with itself great masses of rock, sand and gravel taken from the mountains over which it passed. At length it reached its culmination. The summit of Mount Washington stood out as a lonely island in a frozen sea, while to the north the whole continent was covered, not a single peak rising above the universal pall.

Another period was ushered in by a milder climate known as the Champlain period. The glacier melted at first with extreme slowness, but when thawed down to about 500 or 1,000 feet to where the gravel and stone were, it went forward rapidly and then took place a pell-mell dumping of this material over hill and valley, forming what is known as the glacial drift, of which the islands of our harbor are formed.

At last, owing to the rapidity of the final melting, an immense flood took place, which swept away the finer portion of the material and sand to a lower level or seaward, leaving those perched rocks so frequently met with on hillsides and in valleys.

Everywhere beneath our feet on this peninsula of Halifax where the bed rock is exposed are the deep groovings which attest to the powerful pressure it has been subjected to.

From the labors of Dr. Honeyman, to whom this Institute is so much indebted for the geological problems wrought out by him in illustrating from time to time this drift period, tracing its boulders to their parent source, and by a train of evidence so strongly marked as to leave no doubt as to the distance and direction of their transportation, we learn something of the erosion our province has undergone while participating in this great ice period.

The retreat or melting of the glacier was followed by a re-elevation of the land *en masse,* bringing above the surface an immense deposit of material known as the Champlain sands.

As far as ascertained in the geology of our province the Champlain sands are wanting. Where shall we seek for the immense amount of finer material which must have been produced in this erosion? The conclusion is obvious. The striation on our rock surfaces all point to those off shore banks lying at right angles to the glacier.

Is this deposit too great? Listen to the evidence of Sir Roger Murchieson, one of England's greatest geologists, who, in speaking of the abrading effects of the ice period in which the British islands also participated, says:

"In the silurian formation of those islands alone there is a mass of rock worn from the land which would form a mountain chain of 1800 miles in length, with a breadth of 33 miles, and an average height of 16,000 feet."

This implies a vast amount of finer deposit, and also gives us an idea of the changes that must have occurred in the topography of our province.

In this Dominion, according to Sir Wm. Logan, there is in the triangle formed by Montreal, Champlain and Quebec, an area of 9,000 square miles of the Champlain sands and clays, containing few boulders, and carrying grains of magnetic iron and garnets.

Before us this evening we have a fair sample of sand taken from Sable Island. The cor-relation of this material with that of Sir Wm. Logan's is very striking. There are few or no boulders found on the Island. The sands are siliceous and carry magnetite and garnets, in every way equivalent to the Champlain sands.

This deposit at Montreal has an elevation of 500 feet, and may be traced in a continuous line 400 miles to Nantucket, where it merges into the off shore deposit.

It is evident we cannot hesitate in referring those sands to the same origin.

It would be idle to speculate on the probability of this whole off shore deposit which the currents have moulded and detached, being once above the surface.

Yet, I think this re-elevation that took place at the close of the Champlain period that uplifted those sands 500 feet at Montreal and gave Sable Island such an elevation that at this later period after its being for ages exposed to the ravages of the waves of the broad Atlantic so much is yet visible, would be quite adequate to uplift the whole embankment and form a sand continent equal in extent to the combined area of Nova Scotia and Newfoundland.

At the opening of this, or what is known as the modern period, we have entered upon another downward movement, a gradual subsidence being now in progress over the whole northern part of this continent, of which there is ample proof.

By observations at Nantucket and other points along the eastern seaboard, the subsidence has been 30 feet. The inundations that have of late so perplexed the railway people and farmers along the New Jersey coast attest to this change of level. In our own province we have the evidence given by the submerged forest at Bay Verte and other places in the Bay of Fundy; also the difficulties of keeping up the dykes at Grand Pre, owing to, as the farmers say, the tides rising higher than formerly, and the fact of hundreds of acres of grass lands being given up to the sea from the same cause, no later than last winter at Horton.

A few months ago, in company with Mr. John Woodworth, of Grand Pre, I traversed the shelving beach off Long Island, which is bared at low water for ¾ of a mile. From the channel to the shore we traced stumps and roots of forest trees, some of which would be covered at high water to a depth of 45 feet. Now, startling as this may appear to many, it is strictly in accordance with the geological changes that have taken place in all past ages.

This rising and falling of the bosom of mother earth tells of life within.

Sometimes she heaves a sigh and we record an earthquake. And when those movements cease and she assumes the condition of a dead planet, as the moon is thought to be, we, her children, will also cease to live. But I digress.

This off shore accumulation, having partaken of the upward movement at the close of the Champlain period, would also in sympathy with the coast partake of the subsidence now in progress.

This, aided by the leveling effect of waves and currents, would soon reduce it to the condition we now find it, with its summit alone above the water.

The rapidity with which it has reached its present condition can be judged by the changes that have occurred in the outline and area of this island since its discovery, to some of which I will turn your attention.

It is evident from the familiar manner in which those early navigators resorted to this place, it had a much greater area and importance without the dangerous surroundings it has to-day.

In 1560 Baron de Leroy arrived on the coast and finding it too late to get his colony under cover before winter would overtake him decides on returning, but first placing his cattle on Sable Island and sails thither. In 1598 Marquis De la Roche reached Cape Breton with his convict colonists, and fearing they would escape if left on the mainland prefers trying Sable Island, and heads his vessel accordingly.

Five years after the King of France sends for De la Roche's pilot and orders him to proceed to Sable Island and bring back the convicts.

In subsequent years companies were formed in Boston and elsewhere for the purpose of hunting wild cattle on this island for their hides.

One of the party reports having seen over 800 head of cattle and many foxes, some of which were black. Unfortunately we have no dates from which to arrive at its former size, except that furnished by loss of area since the establishment of the government life-saving station, during which time (85 years) it has been reduced to one-half its extent.

This is independent of charts and surveys, which some have thought may not have been reliable, but such changes as necessitated the removal of buildings, light-house, etc.

I am not at liberty to assert that the present rate of denudation has been in force ever since those early voyagers visited the island. Nevertheless, after careful consideration and allowing for periods of comparative repose it may have enjoyed, I think I am warranted in placing the dimensions of this island at the time of its occupancy by the French convicts at least equal to an area of 80 miles in length, 10 miles in breadth, and a height not less than 300 feet, with an extensive harbor, having a northern entrance and a safe approach.

I do not believe an island of smaller extent so situated and surrounded by the same influence would at the end of 280 years be above the breakers.

As late as 50 years ago it had a commodious harbor, to which fishing vessels on the banks would run for on approach of a storm.

During a gale in 1836 its entrance was closed, shuting in two American vessels, whose ribs are now buried in the sands.

Early English charts show an entrance on the north side which, in consequence of the depth of water on this side, would render approach thereto quite safe.

At that time also the survey gave the elevation of the sand cliffs as 200 feet, which enabled vessels to make the harbor more readily. A shallow lagoon now exists in its stead, separated from the ocean by a narrow ridge of sand.

In order to show the ravages committed by storms and currents on this island I will enumerate a few instances.

In 1813, during a single gale, an area equal to 3 miles long and 40 feet wide was carried away. Within four years previous 4 miles of the west end disappeared. This necessitated the removal of the main station, which was then located at a distance of 3 miles below.

In 1820 this station was again moved 4 miles further east, the sea having encroached upon it. In 1833, there being but ½ a mile between it and the sea, it was again moved 4 miles further eastward. Once more the sea advanced, obliging them to abandon this station and erect new buildings at about the centre of the island.

At this time the late Hon. Joseph Howe visited this place as a commissioner.

On his return he made the startling report that by actual measurement in 30 years 11 miles of the west end disappeared.

In this excessive removal of sand cliffs, a bar was formed over which the seas broke before reaching the cliffs and thus lost their abrading force and gave the west end a short respite. But gradually the currents removed this bar or shoal and the seas began again to manifest their force.

In addition to this gradual work of erosion great areas were removed bodily.

During one gale in 1881 70 feet by ½ a mile departed. A month later 33 feet of the whole breadth of the island disappeared in a few hours; and the following gale 48 feet by ¼ of a mile was carried away bodily, causing a hasty removal of the light-house apparatus. The place where the light-house once stood has passed seaward.

I need not dwell further on this evidence of demolition, enough has been given to show the destructive character of the forces still in operation.

Therefore, in seeking for the origin of this interesting island, I think I am justified in referring it to the Champlain period, that period which lifted from the deep that vast agglomeration of detritus as if to testify to the destruction wrought in the former age by the glacier, that ponderous engine of nature that has so scoured and remodeled the face of this continent.

As to its probable submergence, if then this island and its submarine surroundings belong to the Champlain period, and those are Champlain sands, we are enabled to comprehend aright the many changes that have come to this sand island or sand embankment.

It is apparent that an island so constituted, having no solid strata whereon to rest, even if not participating in the general subsidence this coast is now undergoing, exposed to the full force of the unbroken waves of the Atlantic, before whose power its sand cliffs melt away in a manner that must be seen to be understood, must and will soon disappear beneath the waters.

Art. IV.—New and Rare Plants.—By Dr. Somers.

(*Read November* 9, 1885.)

I wish to make a record in the Transactions of some few plants sent to me during the past year.

1. J. M. Jones, Esq., forwarded a specimen of Swamp Thistle, Circium Muticum Mich, presenting all typical characters of the species. Though common in U. S. I find no previous record of it in our list.

2. Miss S. Gossip, of the Brunswick Street School, found a plant of the Low Ladies Slipper, having a purely white flower, that is, the Labium or showy part of the flower of this plant, instead of being of pink color streaked with darker lines of pink, was pure white. Miss. S. Gossip tells me she had found a similar plant some year or two ago in the same situation. The locality of this plant of Miss Gossip's is one much favored by the colored plant, viz., on Ironstone or Gneissoid soil, overgrown with white pine and tolerably clear of underbrush. The recurrence of the white flowered plant might induce us to look for a form of variation which may become permanent. It is any way an example of that Dimorphism or variation so common in some forms of plant life which fills our books with descriptions of species that are nothing more than varieties, and of varieties that deserve no permanent record of their existence. Witness the compositæ, wherein very many genera and species might with harmony and greater scientific accuracy be reduced to fewer typical forms. We find however in the species of plants now presented, at least speaking of the indigenous, but little tendency to vary from their type. In Gray's Manual, 5th edit., 72, Cypriped acaule is described just as we find it about Halifax (with rarely white). In Wood's Class Book, ed., 73, no mention is made of its being ever white-lipped; however, I find in Amos Bartar's Manual, 6th edition, 1833, W. & B. are placed before its description, but I am inclined to think he refers to mixed white and purple colours in the lip of the ordinary plant, and not to a purely white

specimen. Miss Gossip has kindly engaged to seek for the plant in the same locality during next season, and I think it a commendable object for others to seek for the same in other localities. I may say for myself that in my botanical excursions, extending over several years, I never found a white specimen of C. acaule.

I here present you an unusually large specimen of ground-nut, kindly sent me by Mrs. W. Stairs; it was dug up in her garden, weighed 3oz. when fresh, measures six and one half inches around its smallest diameter and 8 inches in its larger. The plant producing this tuber grows abundantly in the Southern and Middle States, is a favorite food of hogs and burrowing rodents. I think it is not indigenous with us. The remarkable thing about our specimen is its size. As it is edible, it has been sometimes proposed to cultivate it like the sweet potato. It belongs to the Leguminaceæ. Linnæus named it Glycin Apios, but American botanists have named it Apios tuberosa, erecting it into a new genus.

It is cheering to us in our work to find ladies coming forward to aid in any department of it, and the least we can do is to encourage their good will, and endeavour to attach any who may feel inclined to the work of the Institute.

I found, during last September, Solidago sempervirens L. growing very abundantly and well developed on the borders of the salt marsh a little back from Navy Island Cove, Bedford Basin, leaves dark green, smooth stems, fleshy, broadly lanciolate slightly clasping heads, dense flows, beautiful golden yellow. I don't remember of its being mentioned in our list, I have not had time to look. I will here record also the finding of Polygala Sanguinea L. growing in moderate abundance in the dry soil covering a ledge of clay slate exterior, running from the swamp back of Block-House Pond through George Deal's farm to the old Marg. Bay Road; the only locality, so far as I know, where it is found hereabouts. It has not been reported from other places in the province; whether this is its original site, or that it has been brought here in an extraneous manner, I am not prepared to say.

J. S.

ART. V.—SUPPLEMENTARY LIST OF PLANTS COLLECTED IN AND AROUND TRURO, DURING THE SUMMER OF 1885.—BY G. G. CAMPBELL, B. SC.

(*Read Mar.* 8, 1886.)

RANUNCULACEÆ.

Anemone Virginiana, Linn. Salmon River Bank, July 24, 1885.

Actæa rubra, Bigel. East Mountain, Onslow, and Salmon River Bank. In last locality with white berries and *slender* pedicels.

FUMARIACEÆ.

Dicentra Cucullaria, DC. The Falls, May 25, 1885.

DROSERACEÆ.

Drosera rotundifolia, Linn. Truro, common.

CARYOPHYLLACEÆ.

Silene inflata, Smith. Lately introduced with lawn grass seed.

Sagina procumbens, Linn. Common all around Truro.

LEGUMINOSÆ.

Trifolium agrarium, Linn. (Mr. Longworth.) Lornedale Farm.

T. procumbens, Linn. Weed in cultivated grounds, not common.

Desmodium Canadense, DC. East Mountain, Onslow.

Apios tuberosa, Moench. Salmon River Bank, Bible Hill.

ROSACEÆ.

Geum Virginianum, Linn. Salmon River Bank, Bible Hill, July 22.

Potentilla argentea, Linn. Valley of Leper's Brook, Truro, July 20.

P. anserina, Linn. Salt marsh at Lower Village.

Fragaria vesca, Linn. Onslow, East Mountain Fruit, July 10.

Rubus Canadensis, Linn. Smith's Mills, about 2 miles from Truro.

R. hispidus, Linn. Smith's Mills, about 2 miles from Truro.

Rosa Caroliniana, Linn. Common.

Pyrus Americana, Linn. Common on wooded banks.

Amelanchier Canadensis, T. & G., var. *oligocarpa*, Gray. New Annan Mountain, May 26, 1885.

CRASSULACEÆ.

Sedum acre, Linn. Gravelly roadside, Truro.

UMBELLIFERÆ.

Hydrocotyle Americana, Linn. July 20, 1885.

Osmorrhiza brevistylis, D. C. Onslow, East Mountain, and Salmon River Bank, June 14, 1885.

ARALIACEÆ.

Aralia racemosa, Linn. The Falls, Truro, July 21, 1885.

Viburnum nudum, Linn. Common, June 25, 1885.

V. Opulus, Linn. Smith's Island, June 25, 1885.

ERICACEÆ.

Vaccinium Pennsylvanicum, Linn. Common, growing with vacillans and Canadense, June 3, 1885.

Pyrola secunda, Linn. July 8, 1885.

Chimaphila umbellata, Pursh. The Falls, Truro.

PRIMULACEÆ.

Anagallis arvensis, Linn. Introduced lately.

SCROPHULARIACEÆ.

Euphrasia officinalis, Linn. Not common at Truro.

LENTIBULACEÆ.

Utricularia vulgaris, Linn. Ponds on the Salmon River.

POLYGONACEÆ.

Polygonum aviculare, var. *erectum*. Cultivated grounds.

P. arifolium, Linn. Salmon River Bank, Bible Hill.

P. sagittatum, Linn. Truro, August, 1885.

P. Convolvulus, Linn. Common.

P. dumetorum, Linn. Salmon River Bank, Bible Hill.

TYPHACEÆ.

Typha latifolia, Linn. Common.

CONIFERÆ.

Taxus baccata, Linn, var. *Canadensis*. Common.

THYPHACEÆ.

Sparganium simplex, Hudson Smith's Mills, near Truro.

ORCHIDACEÆ.

Habenaria obtusata, Richardson.

H. tridentata, Hook. Common.

H. fimbriata, R. Br. Growing with psycodes in wet places.

Corallorhiza multiflora, Nutt. Onslow, East Mountain.

LILIACEÆ.

Smilacina racemosa, Desf. Salmon River Bank.

GRAMINEÆ.

Phleum pratense, Linn.

Agrostis vulgaris, Withering.

Brachyelytrum aristatum, Beauv. Woods, common.

Spartina cynosuroides, Willd. Banks of ponds.

Poa annua, Linn. Common.

Triticum repens, Linn. Too common.

Hordeum jubatum, Linn. Salt marshes.

EQUISETACEÆ.

Equisetum limosum, Linn. Ponds on Salmon River.

FILICES.

Botrychium Virginicum, Swartz. Deep woods, Salmon River Bank, Bible Hill; not common.

ART. VI. — ADDITIONS TO THE LIST OF NOVA SCOTIAN FUNGI. By J. SOMERS, M.D.

(*Read Feb. 8th*, 1886).

THE following plants enumerated in the subjoined list have been collected during the past season, viz.:—

Agaracini.

1. Agaricus (Armillaria) melleus, *Vahl.*, growing on decaying stumps of trees, Dutch Village. Peculiar for its silky veil, concrete with the stem.
2. A. (Lepiota) gliodermus, *Fries*, vescid, Lepiota, under spruce in many places.
3. A. (Clitocybe) giganteus, *Fr.*, pileus, umbillicate, over 15 inches across. Oct., growing by roadside near Four-Mile House.
4. A (Pleurotus) salignus, *Fries*, on poplar, not uncommon, Sept.
5. A. (Pleurotus) chioneus, *Fr.* snowy pleurotus, growing on twigs, D. Village, pileus thin villous, resupinate, small, or minute.
6. A (Pleurotus) lignatilis, *Pers.*, growing mostly on beech trees; near 3-Mile House. Very fragile, pileus varying in size, and densely crowded on the branches in an imbricated manner of growth, Oct.
7. A. (pleurotus) applicatus, *Bull*, on small stumps cut close to the ground, Geo. Deal's, Dutch Village, Sept., 1885.
8. Agaricus (tricholoma) equestris, *Linn.*, under fir trees, Deal's, Dutch Village, Sept.
9. A. (tricholoma) murinaceous, *Bull*, mouse colored tricholoma pileus umbonate silky, three inches, stem solid, slightly fistulous, Sept., in same locality as above.
10. A. (mycena) luteo vel flavo albus, *Fr.*, October, Four-Mile House woods.
11. A. (hebeloma) rimosus, *Bull*, same locality.
12. A. (pholiota) capistratus, *Cooke*, near the side of a road, McNab's Island.

13. Lactarius piperatus *Fries.*
14. L. vellerus *Fries.*
15. L. *sp.?* All growing in open spaces in the woods.
16. Gomphidius (glutinosus) var. roseus, *Fr.*, in woods. Not common.
17. Cantharellus (cibarius) *Fries.*, McNab's Island, Sept., 1885.

Polyporei.

18. Polyporus dryadeus *Fr.*, dripping polyporus, on dead trees, Dutch Village. distils a gelatinous fluid which soon hardens.
19. P. nigricans *Fr.*, growing on birch trees, McNab's Island.
20. P. Ignarius *Fr.*, rusty hoof polyporus, on poplar. Deal's woods, Dutch Village.

Clavarinei.

21. Clavaria botrytis *Pers.*, common in spruce groves, Sept.

Sphæronemei.

22. Sphæropsis malorum *Berk.* Apple sphæropis, on windfalls.

Dematiei.

23. Cladosporium dendriticum *Wallr.*, on leaves and fruit of apples, pears and other species of the Rosaceæ. This cladosporium attracts attention to it because of its ravages in our apple orchards, many of our apples produced during the past season being rendered by it almost unfit for merchantable purposes, more especially the variety known as Bishop Pippin, of which very few, if any, of this fruit offered in our market could be said to be free from it. As the life history of this fungus may be of interest to fruit growers, I subjoin in an abridged form a paper taken from the *Gardener's Chronicle* of November 28th, 1886, by G. W. Smith, of Dunstable, England, in which he says; "The worst form of cracking in Apples and Pears is caused by a fungus named Claudosporium dendriticum, *Wall.* It not only attacks the fruit and causes serious cracking, but in spring it grows upon the leaves and forms black dentritic spots (arborescent) a quarter of an inch or more across. The fungus also attacks all parts of the

flowers, and often causes abortion of the fruit. The spots are round depressed black, with a white membraneous margin, formed from the cuticle of the fruit. The black portion is a compact mass of spores of the fungus growing underneath the cuticle. These grow continuously, and as they grow they tear open the cuticular membrane, and the mycelium, which lives and feeds upon the juices of the fruit, burrows into the flesh and causes cracks. The cracks, at first slight, become at length confluent, finally produce deep fissures, which, exposing the substance of the fruit, causes it to rot."

ART. VII —THE CARBONIFEROUS OF CAPE BRETON.—BY EDWIN GILPIN, JR., *A. M., F. G S., F. R. S. C., Inspector of Mines.*

(PART I.)

THIS formation is conspicuously developed in Cape Breton, and, apart from the fisheries, to its presence is due what measure of prosperity the Island enjoys. Its soils in the limestone districts are very fertile, and the poverty of the clays overlying the coal measures and the Millstone Grit is counterbalanced by the stores of coal which have been extensively worked. Surrounding great part of the Western and Southern shores, and fringing the Bras D'Or Lake, it is accessible to the farmer and the miner, and ready outlets are afforded for its productions.

Sir William Dawson, in his Acadian Geology, divides the formation, as met in the Lower Provinces, into five subdivisions:

I. Upper Coal Formation.
II. Productive Coal Measures.
III. Millstone Grit.
IV. Marine Limestone Series.
V. Lower Coal Measures.

Some districts do not present all these sub-divisions, the lowest one being frequently wanting or sparingly represented; and in many cases no division line can be drawn between the Millstone Grit in its passage upward into the Productive Measures or downward into the Marine Limestones. The most instructive section is that presented in Cumberland County, where all the subdivisions can be recognised in passing from Hillsboro, in New Brunswick, to the Joggins, in Cumberland Co. In Cape Breton this gradual passage of the subdivisions is strongly marked in several cases.

Here the Carboniferous measures may be said, roughly speaking, to occupy three principal districts. The Western District, with the exposures of Bay St. George and Port *à* Port, in Newfoundland, forms the Eastern rim of the great Carboniferous basin of the Gulf of St. Lawrence. Its former immense extent is marked by the Bonaventure series of Gaspe and the Carboniferous Limestone, etc., of the Magdalen Islands, north of Prince Edward Island, and of Pictou and Antigonish Counties. Beginning at Cheticamp, this division extends along the North-Western shore of the Island, gradually widening, until at Lake Ainslie it is about fifteen miles wide; it then narrows, until at the Northern entrance to the Strait of Canso it appears connected with the Carboniferous of Nova Scotia proper.

Another district, beginning at the southern end of the Strait of Canso, spreads out in two arms, one running between Lennox Passage and the Sporting Mountains, passes to the North of St. Peter's and terminates at Cape George; the other, continuing up the River Inhabitants, crosses into the water-shed of the River Dennys, and passing along both sides of St. Patrick's Channel, finally terminates at St. Anne's Harbour. Along its northern edge, from Whyhogomah to St. Anne's, it projects in long narrow tongues among the crystalline rocks.

This district connects through Boularderie Island with the third or eastern district, which extends from Cape Dauphin through Sydney to the Mira River. Connecting with this district is a long irregular band of the same measures, extending along the Salmon and Grand Rivers.

In addition to these principal divisions there are numerous small isolated patches of carboniferous measures along the south-eastern shore of the Island, which, taken in connection with the exposures of Guysboro, St. Margaret's Bay and Chester, in Nova Scotia proper, would show that once the Atlantic front of the Province was covered by the lower measures at least of the Carboniferous system. The pre-cambrian rocks of the Bras d'Or Lake are generally flanked by narrow fringes of the Marine Limestone and Lower Coal Measures.

At St. Lawrence Bay, in the extreme North of the Island, is a considerable area of Lower Carboniferous Measures, as is also the case at Aspy and Ingonish Bays. Between these points the pre-cambrian felsites and syenites either come boldly to the sea or have a narrow fringe of these measures.

The general arrangement of the Carboniferous of the Island is that of valleys between the ridges of the older rocks, and their softer strata have been worn into broad river valleys and rolling hills of inconsiderable altitude. When they rest on the flanks of the pre-carboniferous hills they present charming and picturesque gorges worn by the brooks which are long nourished by the accumulated winter snows.

The Eastern or Sydney district presents unusually fine natural sections, and has received much attention owing to the extensive mining operations which have been carried on during the past century. Its structure has been carefully worked out, and as it is a typically well developed carboniferous district a brief description of the various subdivisions will serve in great measure as a guide to these in other parts of the island.

In the Sydney or Eastern district the following subdivisions are recognised:—

Productive Coal Measures.

Millstone Grit.

Marine Limestone Formation.

Lower or Basal Coal Measures.

The upper subdivision, that of the upper Coal Measures, being absent, unless represented by the beds at Low Point, overlying the Carr Seam.

The shore from Cape Dauphin to Mira Bay is occupied by the productive measures, which are folded in three undulations having a general East and West course. As the measures are interrupted at the anticlinals the exact identification of the seams has not been made out.

The following section, taken in the Lingan district, will serve to show the thickness and relative positions of the best known seams:—

Seam.	Strata and Coal. ft.	in.
Seam A	3	..
"	306	..
Carr	6	5
"	190	..
Barrasois, Hub or Block House	12	1
"	379	3

Seam.	Strata and Coal. ft.	in.
Harbor, Victoria or Sydney	8	..
" "	234	..
Seam D	3	..
"	78	..
North Head	4	..
"	75	..
McAuley, Phelan, or Lingan............	8	..
" "	95	..
Ross, or Emery	4	6
"	340	..
Gardener.........................	4	9

A somewhat different arrangement is suggested by Mr. P. Neville, Deputy Inspector of Mines, who has had much experience in tracing the seams of this district, and he correlates those of the districts South of Lingan as follows:—

Cow Bay.	Schooner Pond.	Big Glace Bay.	Little G. Bay.	Bridgeport.
Block House Seam, 9 ft.	....	....	Hub Seam, 9 ft. 10 in.	....
Gowrie Seam, 5 ft.	....	....	Harbor Seam, 5 ft. 6 in.	International Seam, 5 ft. 6 in.
Big Seam, 8 ft.	....	Ontario Seam, 8 ft. 6 in.	Caledonia Seam, 9 ft. 6 in.	Reserve Seam, 9 ft. 6 in.
Seam, 5 ft.	McPhail Ross Seam, 5 ft. 6 in.	Seam, 5 ft. 10 in.	Seam, 5 ft. 8 in.	Emery Seam, 5 ft.
Long Beach Seam, 3.2 ft.	Seam, 3 ft. 4 in.	Seam, 3 ft.	....	Lorway or Gardner Seam, 4 ft.

The coal field is remarkably free from disturbances, etc., and Professor Lesley, in a report, dwells strongly on this point.

Nearly all the seams lie at easy angles, yield little water, and owing to the generally firm character of the roof, they can be mined with unusual cheapness and safety. So strongly marked is the impermeable nature of the strata, that at a moderate depth the submarine workings are perfectly dry.

Shales, arenaceous and argillaceous, with red and green marls, make up about one-half the total thickness of this section. The shales pass into sandstones and frequently carry ironstone nodules, and the more argillaceous beds are crowded with fossils, chiefly ferns. Many trunks of erect and prostrate sigillariæ, with roots attached and grown into the coal, are seen in these shales; they have been observed nearly five feet in thickness, but those which have come under my notice have not usually exceeded two feet in diameter. The term marl is applied here to beds not necessarily calcareous, but to red and green shales which crumble readily on exposure. Sandstone beds, gray and white in colour, and often fifty feet in thickness, are met at frequent intervals, and nearly always occur a few feet above a coal bed. Many of the sandstone beds are calcareous, and are then flaggy micaceous, and sometimes ripple-marked.

Almost invariably underclays highly charged with stigmariæ roots and rootlets, and from a few inches to eight feet in thickness, form the floor of the Coal seams. In a few instances Coal seams rest directly on thin beds of fossiliferous limestone, and in one instance the floor is sandstone. Beds of black bituminous limestone, from a few inches to three feet in thickness, have been observed about the middle of the section. The physical characters of the coal beds will be referred to in connection with the analyses to be given in the appendix, and it may be remarked here that they resemble in many points those of the Durham district in England.

The division line between the Millstone Grit and the Productive Measures is an arbitrary one, and, as marked on the Geological Survey maps, is considered by many as encroaching on measures which may fairly, so far as their coal contents are concerned, be considered productive. This opinion is strengthened by the fact that a large collection of plants from the Cossit pits, a short distance east of Sydney town, at a horizon considered low down in the Millstone Grit, were reported on by Sir William Dawson as distinctly marking the productive horizon. Further investigations may show that the distinctions at present laid down as separating the upper part of the Millstone Grit from the Coal Measures are due more to local conditions of deposition, which have modified the Coal Seams and their encasing strata, than to any change of the distinctive features of the preceding horizon.

As compared with the productive measures, these strata show a much larger percentage of sandstones, frequently coarse and sometimes conglomeritic. There are fewer argillaceous layers and much false bedding. Near the old syenitic and felsitic rocks the prevailing color is red ; further away, where the material has been derived from the preceding Carboniferous horizons, gray shades are met. The formation is also distinguished from the Productive and the Marine Limestone series by the absence of calcareous matter. Numerous coal seams are met, some of which are persistent over long distances and of workable dimensions. Others are not at present considered of value in the presence of the large seams now worked, but will prove in the future an important source of coal. This series stretches from the Mira River to the Eastern shore of Sydney harbour, and then widens until it occupies nearly all Boularderie Island. The maximum thickness in this district is 5,700 feet, but it rapidly diminishes to the Northward, until at Cape Dauphin only 500 feet is exposed.

A long arm of millstone grit extends up the Salmon and Mira Rivers and overlaps unconformably the marine limestone and basal conglomerates, and rests against the Mira and East Bay felsites. The underlying divisions of the carboniferous crop at various points throughout the district, and extend irregularly through Loch Lomond and Grand River to St. Peter's.

This outlier presents the outcrops of several small seams of coal apparently underlying a large extent of ground. There has not been any attempt made to find other seams, or even to test the value and extent of these outcrops. The measures including the coal seams possibly represent the upper part of the millstone grit as exposed to the eastward of the Productive Measures of the Sydney Coal Field, and are on a horizon corresponding to that of part of the millstone grit lying south of Sydney town, where similar outcrops of coal are found.

The Marine Limestone formation occupies a triangular tract of ground between the arms of Sydney harbor, and attains a thickness of about 2,000 feet. It is composed principally of red and gray shales, sometimes approaching marls in aggregation, argillaceous and calcareous, and frequently carrying nodules of limestone and iron ore. Numerous beds of limestone are met, compact, laminated, or concretionary, usually gray and blue, sometimes black and bituminous. These are frequently associated with beds of gypsum and anhydrite, sometimes over 100 feet in thickness. Beds of red and gray Sandstone, usually laminated, often micaceous and ripple-marked, are frequently met. The limestones generally carry the fossils characterising the formation, and are frequently charged with galena and copper pyrites, celestine, manganese ores, etc.

The following section, taken from the report of H. Fletcher, Esq., of the Geological Survey, for the years 1875–76, gives a good idea of the conditions under which the limestones and gypsum are usually presented:—

	ft.	in.
Bluish gray columnar limestone	136	0
Measures concealed	50	0
Green marl	9	0
Black bituminous nodular, gray and mottled compact limestone	55	0
Gray compact and variegated limestone, with fossils and layers of marl	40	0
White crumbling gypsum	15	0
Green gypseous marl	0	7
Greenish gypseous marl, with streaks of pink gypsum	1	6
Red micaceous marl, with green blotches and thin wavey layers of gypsum	7	0
White gypsum in nodules with marl	1	0
Gypsum and marl, with veins of white and pink gypsum	1	6
Nodular gypsum, with emerald green blotches and a pink layer	1	0
Nodular gypsum, and red arenaceous marl, and blue thick-bedded limestone	—	—

The gypsum varies greatly in appearance and quality, and the following description of an immense cliff of it on the Bras d'Or Lake will serve to show its characteristic features:—

It is essentially white, but tinted and spotted with many colours. It occurs in beds, often massive but frequently jointed in every direction. It is compact, or granular, minutely crystalline, or fibrous and radiating. Crystals of selenite of a brownish or white colour frequently occur in it; they are isolated, or arranged in radiating groups, and sometimes give the rock a porphyritic appearance. The rock is frequently traversed by veins filled with fibrous gypsum of various colours, or by large plates of transparent selenite. Layers and nodules of anhydrite and of limestone frequently occur in the beds or divide them. Long-continued weathering roughens the surface of the gypsum, owing to the presence of silica as sand.

These beds of gypsum are sometimes presented as immense lenticular masses, but they often extend for miles as an irregular cliff, reminding the tourist of a ruined marble wall. The vicinity of their outcrops is marked by the luxuriance of the grass, and by the vigorous growth of the evergreens which mask the conical holes formed by the removal of the gypsum through the action of the water drainage of the district. It may be remarked here that possibly some of the irregularities characterizing the outcrop of this rock may be due to the washing away of masses of salt. It is true that at present there is no evidence to show that such deposits existed, but the numerous brine springs issuing from this formation, and the common association of gypsum and salt, afford reasonable ground for anticipating valuable discoveries of rock salt in Nova Scotia in the vicinity of the gypsum beds.

Lower Coal Measures.

This term, as used by Sir William Dawson in describing measures such as those of Horton and Hillsboro, is applied, in speaking of this district, to strata of a quite different character. This, the lowest member of the carboniferous group, corresponds with the Bonaventure formation of Gaspe, and the basal conglomerate of New Brunswick and Newfoundland is in this district of variable volume, and cannot be separated by any strict line from the overlying limestone formation, and it is Mr. Fletcher's opinion that in the districts surrounding the Bras d'Or Lake much of it must be considered contemporaneous with the limestone formation. In the Sydney district, near the Coxheath Hills, it has a thickness of 2,525 feet, which rapidly diminishes as its strike is followed to the North and the South.

This formation in the Sydney or Eastern district presents itself generally as a friable reddish conglomerate, the pebbles varying in size up to a diameter of three feet. The masses are frequently of little coherence, in some cases the matrix is calcspar, hematite, or quartz. The conglomerates, the distinguishing feature of the formation, alternate with masses and beds of reddish, coarse and fine grained, friable sandstones, and with beds of red and green marl and an occasional bed of limestone. Usually the upper beds are finer than those near the base of the formation, and the line between it and the succeeding horizon may be said to be drawn at the first plainly marked calcareous deposit, which is not unfrequently a coarse arenaceous limestone obscurely fossiliferous.

Passing to the westward we meet the Carboniferous of St. Peter's Bay and the River Inhabitants. The marine limestones and some beds of the lower horizons border St. Peter's Inlet and Bay and the northern shores of Isle Madame, and passing to the north under the higher measures skirt the Sporting Mountains, and passing round the head of West Bay fill the valley of the River Inhabitants and are exposed on the shore of the Strait of Canso at Plaster Cove. These strata show at several points sections more closely resembling the typical lower coal measures of Nova Scotia than any met in the Eastern district. The colouring of the geological maps of the Canadian Survey does not separate these two subdivisions. They extend northward until they reach the River Denny's Basin, and stretch to the Grand Narrows and the Little Bras d'Or.

The officers of the Geological Survey have grouped the Carboniferous measures overlying these strata, in the district we are now considering, under the term "Middle Carboniferous," including millstone grit, productive measures, and some beds referred with doubt to the upper coal formation, as the dividing lines are obscure, and the structure not yet fully worked out.

The problem presented by the Carboniferous of the River Inhabitants is a difficult one, and complicated by the apparent anomaly of part of the coal horizon being connected with gypsum and limestone. Mr. Fletcher estimates the total thickness of the Carboniferous rocks at 21,960 feet, which probably embraces all the divisions already described in the Eastern district, and the 1,350 feet of strata referred to by him as overlying the Little River Coal Series (8,926 feet thick) may represent part of the Upper Coal Division (No. 1) of Sir J. W. Dawson.

The measures of the district do not present features calling for special notice, and the description of the various subdivisions of the Eastern district may be applied here. Some of the sandstones and shales of the River Inhabitants are little more than compact sand and mud, while at other points they present the normal hardness of the carboniferous strata.

But little is yet known about the extent and value of the River Inhabitants coal fields. A very considerable area of coal-bearing strata is indicated by the widely-separated coal crops at the mouth of the River and around the Basin. The paucity of outcrops, coupled with the presence of several large faults ranging through the district, have discouraged prospecting in the face of a dull coal trade. In the future the advantage of an all-winter shipping port, like that of Carribacou Cove, will no doubt stimulate the development of coal mines here, when the export of coal to the United States begins again.

In order not to unduly extend this paper, I will on another occasion give a brief description of the carboniferous districts of the Western shore of the Island, and of their coal fields, with analyses of the coal and other economic minerals found in them.

ART. VIII.—POLARISCOPIC EXAMINATION OF CRYSTALLINE ROCKS OF ANTIGONISH COUNTY.—BY REV. D. HONEYMAN, D. C. L., F. R. S. C., F. S. SC.

(Read April 12, 1886.)

THE rocks which I have submitted to this method of examination, by sections, prepared by Dr. A. Julien, are the following:

1st. Two from the "Typical Archæan Series," on Northumberland Strait. *Vide* Papers in Transactions of the Institute, "Geology of Antigonish County," Vol. IV, 1875.

2nd. A section of the summit rock of Antigonish "Sugar Loaf."

3rd. Three sections of the axial rocks of the mountains north of the "Sugar Loaf."

4th. Three sections of the Crystalline rocks in the "Arisaig Mountains."

5th. A section of one of the Arisaig Pier rocks, and another of a rock at Doctor's Brook, on the shore.

No 1 is an Archæan diorite, having the feldspar in large patches in hornblende. I have characterized it as "porphyritic." Our section has both minerals. The hornblende is dichroic. With crossed nicols the other part of the section is (a) sepia coloured with parallel spaces of dark shade, twining lines, indicating a triclinic feldspar; (b) there is also in the white a pleochroism. The corresponding part of the rock treated with an acid effervesces, showing calcite.

Interposing a section of albite, which also shows a sepia colour, without parallels. The effect is very striking. The pale sepia of our rock section becomes light purple and the dark shade parallels indigo.

By the same process we have corresponding effect in the sections of the Nictaux and Wentworth I. C. R. diorites. Trans. 1884, page 121, Nos. 6, 7.

Macroscopically examined this diorite is magnetitic. The magnet shows also the presence of magnetite.

The constituents of this rock are therefore Hornblende, Albite, Calcite and Magnetite.

No. 2 is a section of granitoid diorite.

The Polariscope indicates Hornblende and Albite.

A macroscopic examination of the rock and the use of the magnet show the existence of magnetite.

We have here metamorphic diorites corresponding in mineral constitution with the igneous diorites of Nictaux and Wentworth. Pyrite only is wanting in the former.

No. 3 is a section of the central and summit rock of Antigonish Sugar Loaf. It indicates Hornblende, Orthoclase and Magnetite. The rock is therefore Syenitic. It is dichroic. The opaque portions are seen to be magnetite with direct light. The magnet confirms the observation.

This rock corresponds with that of the elevated grounds on the south side of the harbour, which is in connection with the Lower carboniferous and fossiliferous limestone. The connection is often so intimate, especially on the summit, as to form a breccia. The Sugar Loaf rock is in conjunction with metamorphic slates which we have regarded as Cambrian (?).

The elevation of the syenite with fossiliferous limestone is 300 feet above the sea level (Bayfield); that of the Sugar Loaf is 760 (Bayfield.) The difference, 460, may therefore be regarded as the approximate height of the Sugar Loaf above the sea level, at the beginning of the Lower Carboniferous Period, when the conglomerate and limestone of the Doctor's Quarry at the foot of the mountain were in process of formation.

Devonian (?).

In the mountains, about one mile north of the Sugar Loaf, we find out-cropping other Crystalline rocks. A bluff of the series is a prominent feature of the east side of Right's River. (*Vide* Paper IV., page 71, 1875.) Of these I have 3 sections. In all the rock appears unindividualized.

No. 4. The section of the bluff rock is very striking. The rock is full of kernels of calcite (amygdales ?)

These in the section with polarised light are beautifully pleochroic with radiating structure. The rock seems to be a mixture of hornblende and feldspar.

No. 5 is dichroic with opaque portions. Magnetite ?

Other three sections are (1) of Arisaig Pier rock ; (2) of a Saw Mill rock, in the mountains, and of Doctor's Brook, south of Arisaig Pier ; (3) of mountains west of the Saw Mill.

No 6. (1) section, of Arisaig Pier rock, an igneous rock of Lower Carboniferous age, shows rock unindividualized with kernels of calcite and magnetite.

No. 7. (3) unindividualized with magnetite grains. This is apparently of Devonian age.

The examination of the Nos. 4, 5, 6, 7, is not so satisfactory as of 1, 2 and 3.

ART. IX. — OBSERVATIONS ON THE CURRENTS IN THE GULF OF ST. LAWRENCE, AND THEIR DANGER TO NAVIGATION. — BY JOHN J. FOX.

(*Read May* 10, 1886.)

THE remarks in this short paper are deduced from personal experience and observation, after a residence of thirty years at the Magdalen Islands, in the capacity of Chief Officer of Customs.

Seldom a year passes but we have to record the loss of some valuable ship and cargo, with human life, by stranding on the Islands and coasts of the Gulf of St. Lawrence, which, on official enquiry, is attributed to imperceptible currents unknown to the shipmaster, not laid down in the charts and sailing directions now in use.

A general ignorance appears to exist among navigators respecting the force and direction of the tides and currents in this locality, which may in some measure be accounted for by the fact that fifty years have now elapsed since the last survey of the Gulf was made by officers of the British Navy. And it would appear that their observations were confined more to the shore tides than to the currents in mid-channel; some additions have since been made, but the basis is the old survey.

The local currents of the Gulf are created and influenced by various agencies, such as winds, specific gravity, changes of atmosphere and equilibrium. Their existence, force and direction are difficult to ascertain; are very deceptive, and being very irregular are consequently the more dangerous to navigation. They appear to have periods of comparative quiescence and activity. Those born of the winds change with it.

The ice that accumulates in the Gulf during the winter months, combined with the immense volume of fresh water discharged into it in the spring from the St. Lawrence and other rivers by the melting of the snow, decreases its saltness and specific gravity. It also increases its altitude and bulk, and being lighter than the water below floats on its surface and forms a current, which to find its equilibrium sets down in a southerly direction towards Capes Ray and North into the Atlantic ocean.

The ice generally disappears about the middle of May and forms again in such quantity by the end of December as to obstruct navigation.

There are three channels or entrances into the Gulf from the Ocean: one is to the north of Newfoundland through the Straits of Belle Isle, another to the south of Newfoundland, and the third is through the Strait of Canso.

The channel generally used by ships bound to the Ports of Quebec and Montreal, is that to the south of Newfoundland, between Capes Ray and North, and to which these observations, are chiefly intended to apply.

This channel is about fifty miles wide. Twelve miles east from Cape North lies the Island of St. Paul, and forty-five miles in a northwesterly direction are the Magdalen Islands, the distance from thence to the Island of Anticosti is about eighty miles. These Islands lie directly in the track of vessels, bound to Ports in the Gulf.

From Anticosti to the northern end of the Straits of Belle Isle the distance is about three hundred and forty miles. This Strait is twelve miles wide at its northern entrance, and about one hundred miles at its southern, between Cape George, Newfoundland, and Cape Whittle, Labrador, through which is the route taken by the Ocean Steamships from Europe to Quebec during the summer months.

A branch of the Polar current sets in a southwesterly direction through the Straits of Belle Isle, and is stronger on the north, or Labrador coast, than on the south or Newfoundland, the water being deeper there, its velocity is influenced by the winds, and greater in spring and autumn than in summer, when southwest winds prevail with increased temperature. This occasionally creates a surface current setting to the north-east; the colder current below setting through south-west, or in the opposite direction.

Various opinions are held with regard to Icebergs drifting through this strait into the Gulf of St. Lawrence, the correct one appears to be that bergs are occasionally found about its northern entrance. A few years ago one was found aground off Forteau Bay in twenty-five fathoms of water with an elevation of seventy feet above the sea, but Icebergs are rarely, if ever, seen in the Gulf, to the southwest of Anticosti.

A dangerous current sets into the Gulf from the Atlantic Ocean between the Newfoundland and Nova Scotia coasts, and often proves fatal to Ships about Cape Race. It is formed by the Polar Current setting down from the north on one side, and an offset from the Gulf Stream setting in from the southwest on the other.

This current, after passing Cape Race, and along the south coast of Newfoundland, enters the Gulf in a northerly direction, between Cape Ray and Cape North, flowing towards the Island of Anticosti. Its velocity is increased with winds from a south to east direction, it frequently precedes the wind, causing very high tides, and giving warning to the observer on shore of an approaching gale, before any indications are given of it by the Barometer. After passing Cape Ray it is traversed obliquely by the Polar Current, setting down through the Straits of Belle Isle, and deflected to the southwest, then coming in contact with the shoal grounds around the Magdalen Islands, it divides; one portion running to the southwest along the south side of those Islands, and the other continuing its northerly course up towards the Island of Anticosti until coming in proximity to the south shore of that Island, it curves to the westward and falls into the River St. Lawrence current setting out to the southeast.

The southwest stream, after passing the southeast end of the Magdalens, again divides, one portion swerving round to the north and west, up the Gulf towards the Bay de Chaleur, thence round the North Cape of Prince Edward Island, and enters the Straits of Northumberland, through which it flows towards the Strait of Canso. The other portion continuing its southwest course towards the East Cape of Prince Edward Island, and setting round that dangerous promontory, it runs westerly, and meeting the stream through the Straits of Northumberland, turns southeasterly, and along the Nova Scotia coast towards the Strait of Canso, then past the Cape Breton coast, and out of the Gulf between Capes North and Ray, to the Ocean.

The Island of Anticosti divides the entrance to the River St. Lawrence into two channels, called north and south; through these the current from the river sets with great rapidity, in the spring with the melting snow, from two to three miles an hour. The polar current through the Straits of Belle Isle meeting this stream in the north channel, and striking it obliquely, causes those eddies, and counter currents, which are so often fatal to shipping on this much dreaded Island.

The south channel stream sets down from the river in a south and southeasterly direction, contracting and expanding in breadth, by the action of the winds, either to the east or west, and its influence is sometimes felt down the Gulf below the Magdalen Islands. On the twentieth of November, 1880, the steamship "Ottawa" of the Dominion Line, grounded in the "Cap de la Roche" Channel, between Montreal and Quebec, and a portion of her cargo was thrown overboard to lighten her. About four weeks afterwards some of this cargo was found upon the North Beach of the Magdalen Islands, proving, beyond doubt, the force and direction of this dangerous current.

During the summer solstice, when the water of the Gulf attains a high temperature, most of the currents met with there are surface currents and controlled by the winds. The cold Polar current, which sets to and fro from the Ocean, from its greater weight and density sinks below and becomes a submarine current, and a resort for the schools of codfish, mackerel, and herring, which abound in those waters.

To illustrate the influence these dangerous currents have upon ships navigating the Gulf of St. Lawrence, we will suppose a ship passing Cape Race and bound for Quebec with a southerly wind and clear weather. The master, after verifying her position, takes his departure and shapes his course up in a northerly direction, suddenly the weather becomes obscured by fog or snow-storm, which often occurs here, and not being aware of this northerly set or current, he is carried by it ahead of his reckoning, and after passing Cape Ray encounters the Belle Isle current, setting down to the southwest, or obliquely across his track, and before he is aware of the danger, his ship is stranded upon the southeast end of the Magdalen Islands, to the westward of her course, when, by his reckoning, he supposes himself to be many miles from them. Or should he be so fortunate as to steer far enough north to clear the Magdalens (by the same causes), he may find his ship on the south shore of Anticosti, where wrecks so frequently occur.

To ships bound down the Gulf they are equally fatal. After leaving the River St. Lawrence through the south channel, and passing the southwest end of Anticosti, the ship's course down the Gulf is southeast by east; the southwest current from the Straits of Belle Isle, crosses this course and combining with the River St. Lawrence current, setting southerly, carries the ship ahead of her reckoning, and again to the *westward* of her supposed position, upon the northeast end of the Magdalens. Between the years 1868 and 1880, six ships were wrecked in this region, and fifty-five seamen perished, through the influence of these currents.

The ocean current which sets into the Gulf past Cape Race after passing the southeast end of the Magdalen Islands (as I have before observed) takes a northerly direction, and in thick weather is very dangerous to ships bound down the Gulf from New Brunswick Ports, these usually sail with a southwesterly wind, and after rounding the North Cape of Prince Edward Island shape a southeast by east course, so as to clear the south end of the Magdalens which (to use a nautical phrase) brings them sharp upon the wind on the starboard tack, consequently this northerly current runs obliquely to their course, and in light winds, not only retards their headway but sets them to leeward and on shore about the west end of the Magdalens, when the shipmaster by his reckoning judges himself to be at a safe distance to the westward of them. Between the years 1876, and 1881, four ships were stranded on the west end of those islands by the force of this current.

The meteorology of the Gulf of St. Lawrence, has somewhat changed during the past fifty years. Fogs and changes in atmospheric temperature have become more frequent. The cold is less severe in winter, and the winds more variable and of shorter duration in summer, which no doubt has some influence upon the currents there. Many of the prominent land marks, laid down in the charts and sailing directions now in use, have also been washed away by the action of the sea, or submerged, which is misleading to the navigator.

This great commercial highway is traversed annually by a large fleet of magnificent steam and sailing ships, laden with costly merchandize and thousands of valuable lives, and the heavy losses annually incurred through the ignorance of navigators, of the force and direction of the currents crossing their track (which they assert are not laid down in their charts or sailing directions), shews the importance and necessity of a scientific survey being made without delay, to obtain by observation the information absolutely necessary for the safe navigation of the Gulf of St. Lawrence. This should be undertaken by the government, as the loss of every ship is a national loss, and falls upon the community.

ART. XI. — A REVISION OF THE GEOLOGY OF ANTIGONISH COUNTY, IN NOVA SCOTIA.—BY REV. D. HONEYMAN, D. C. L., F. R. S. C., F. S. SC., *Hon. Member of the Geologist's Association, London, &c.*

(Read May 10, 1886.)

THE construction of a line of railway, which passes through this County, has exposed interesting series of rocks which were largely obscure. Geological investigations of cognate series in other parts of the Province have, in turn, cleared up certain doubts in reference to series in the County which are regarded as "Typical." The examination of correlated series elsewhere have contributed somewhat in this direction. The application of the microscope and polariscope to the study of the crystalline rocks, besides revealing the character and constitution of the rocks themselves, seem also to indicate relationship and age, and thereby serve, *in a manner*, to determine the relationship of associated non-crystalline rocks. In some cases, too, comparative palæontology, without lithology, lends its aid in confirmation of certain conclusions. These considerations have induced me to make a revision of the Geology of Antigonish County. In no other County has the geology been so fully investigated. Parts, however, yet remains to be examined. I have wrought in this field as an amateur or Provincial geologist, more or less, during a quarter of a century, and yet corners remain untouched.

TABLE OF FORMATIONS.

1. Pleistocene,—Champlain and Glacial.
2. Carboniferous,—Middle and Lower.
3. Silurian,—

Upper.	"Upper Arisaig," "Typical."
Middle.	Hall.
Lower.	Hudson River.

4. Cambrian ?—"Middle Arisaig."
5. Archæan,—"Lower Arisaig," "Typical."
6. Igneous Rocks.—
   Carboniferous.
   Pre-Carboniferous.

I shall, by means of sections and offsets, indicate the several formations and their relative positions. At the same time, I will take occasion to make illustrative notes.

Section I., on the line of railway from Pictou County line to Antigonish harbour.—The range of mountains on this line commences at a distance of about two miles N. W. of the town of Antigonish, and extends westwards to Barney's River Settlement in the County of Pictou. At this extremity the railway has exposed an interesting junction of carboniferous conglomerate, and igneous rocks. Equivalents of A and B members (Hudson River, Lower Silurian) of the "Fossiliferous Arisaig Series," and the metamorphic Cambrian rocks of the mountains. In addition to this it has given easy access to the mountains, in parts where they have been cleared of forest, and can be examined to greater advantage than in Antigonish County. This is the case nearly up to the County line. (*Vide* "Notes on a New Geological Progress Map of Pictou County."—Transactions of the Nova Scotian Institute of Natural Science, 1880, Vol. V.)

Before reaching the County line, the railway has entered an interesting band of rocks, corresponding with A. Arisaig, as above, both in lithology and palæontology. The strata are hard metamorphic slates. The fossils are scattered through the rock, and are all in the state of casts, with the exception of the *Linguлæ*, which survive, while the others have only left their impressions, external or internal. Other fossils are *Petraia*, *Cornulites* and *Orthoceras*; the *Petraia* are persistent, being found everywhere, and in pretty much the same condition, wherever corresponding strata are found. Occasionally I have found the corals silicified. In two localities only has the coral survived in A, in a state of distortion. I would further remark that these strata succeed the metamorphic Cambrian (?) formation of the mountains, as their relatives do at the western end, without any intervention. I shall again refer to this fact. Another fact may be stated. A large piece of rock was pointed out to me, by my companion, on the mountain side, immediately behind our fossiliferous strata, as something peculiar. It was a conglomerate corresponding with rocks found at Wentworth, in the Cobequid Mountains, belonging to the series of rocks with which I have elsewhere correlated part of these mountain rocks. Proceeding on line of railway, we pass the last outcrop of the fossiliferous rocks at the old stage-coach stables. At Glen-Bard are seen outcrops of the Cambrian (?) rocks. Emerging from Marshy Hope, at the Big Clearing Station, we observe Lower Carboniferous conglomerates, succeeded by limestones.

We are now on the north-west corner of the southern Carboniferous area of the County. Advancing we have limestones, or pits, as far as James's River. Following this river into the mountains, about three miles, we come to a fine waterfall, with rocks rising in peaks, on its sides, to a considerable elevation—estimated about 300 feet. The whole is picturesque and beautiful. Further up, at a distance of two miles, we reach the "Old Mountain Road," with its old clearings. This was formerly a highway between Antigonish and Merigomish.

Returning to the railway and proceeding onward, we enter upon a great belt of gypsum, with occasional limestones. This extends, with occasional interruptions, as far east as St. George's Bay, a distance of fifteen miles. It also passes over to the south, appearing at Addington Forks, and beyond at West River. Reaching Braley Brook, we observe the gypsums rising in a lofty wall, with the brook running along its foot.

Following the brook towards the mountain, we find limestone strata, having brown ochre with calchopyrite coated with green carbonate of copper. This has conglomerate underlying it, which has also green copper carbonate. None of these are of any value. Still advancing, we have the gypsum wall on the right, and come to a small brook, which also issues from the mountain. Going up this brook, we come to a quarry having limestone of considerable quantity and solidity. This quarry furnished the chief building stone of St. Ninian's Cathedral, Antigonish. This also overlies conglomerates. We have already parted with the mountain metamorphic rocks, and come to a break between the two mountain ranges. This break is occupied by rocks of the two carboniferous areas of the County,—conglomerates, grits. A quarry of the latter in the so called "Yankee grant," furnished the other building stone of the cathedral. Still proceeding, we have the gypsums on the right and another brook, Braley Brook, having turned away from our course. On the left side of this brook we have another limestone quarry, with brown ochre. Still further, we pass into conglomerates, and cross Right's River above the factory. Below it is a bluff of conglomerates, with the gypsums outcropping on the side of the river. Crossing the intervale, we come to the railway station at Antigonish. This is also the site of the "Old Salt Works." In my paper "On the Geology of Antigonish County"—*Vide* transactions of the Institute of Natural Science, 1866—I made mention of the salt pond in the Town and salt springs in the County. In my recent paper "On the Geology of Antigonish County," Trans. I. N. S., 1875, is a "History of the Salt Works." Extract: "Mr. Deacon next operated on the intervale below the town, not far from the confluence of Right's River, Braley Brook and West River. Here, after passing through a considerable thickness of clay, impregnated with salt, he came to 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. He accordingly commenced another boring at a point near to the evaporating building; after boring through clays, impregnated with salt to a depth of 65C feet, without finding any indications of brine, that of the other boring becoming too weak for use, and the working capital exhausted, the work was abandoned."

About one mile north of the salt works, we have the mountain called the "Sugar-loaf." The height of this is 760 feet. Its rocks are highly metamorphic slates, argillites. A section of them is seen on the "Old Gulf Road." They are destitute of fossils. The summit rock is syenite.—(*Vide* "Polariscopic Notes." A Paper preceding.) On the side not far from the summit, the argillites outcrop. They are also seen outcropping in a brook at Doctor's Quarry. I have correlated these with rocks in McLellan's Mountain, which I regard as "Lower Silurian metamorphic" (?); overlying these are Lower Carboniferous conglomerates. The upper parts of these have a little green copper carbonate. The ochreous limestones of the quarry overlie them. South of this mountain is another mountain of less elevation—480 feet. The argillites of this are overlaid by conglomerates and limestones of another quarry. Returning to the line of railway: In its farther progress, it passes over to the south side of Antigonish harbour. Here gypsums are seen outcropping on its course as far as South River. Before reaching Williams Point, it comes to heights which rise 300 feet above the sea level. In these are syenites with fossiliferous limestones in closest connection, forming a breccia. The limestones are wholly unaltered. *Leperditia, conularia, &c.*, are found near the syenite, and crystals of Galenite. Here we have a sea bottom, while on the "Sugar-loaf," and other mountains, we have sea beaches of the Lower Carboniferous period. The former have been raised *more* than 300 feet since they were formed, as the fossiliferous limestones occur on the summit as well as the syenites. It is probable that the latter, and the mountain range itself, have been elevated to the same extent.

Section II., from North River, Antigonish harbour, to Cape St. George.—Crossing from Williams point to the mouth of North River, we find the gypsums re-appearing on the north side of the harbour. Up the river, on both sides of the Harbour Road, they are very largely developed, and they continue still farther towards the mountains. Beyond this conglomerates occur as far as the mountain rocks. At Town Point, on the harbour, "Mr. Deacon made a six-inch boring, and lined it with iron tubing. At a certain depth in the soil and clay, he entered gypsum. He came to sandstone without finding any indication of brine, and concluded that further operation in this locality was useless." This was his first boring. Back from this, nearer the mountain, gypsum is seen rising to a height of fifty feet. I would here remark that all these altitudes are taken from the Admiralty Chart of Antigonish harbour. After another interruption, they re-appear, having the same height, advance to the road, where they are cut off by it; disappear again, pits only showing their existence underneath, and re-appear on St. George's Bay. The mountains come forward at the same time and end near the road. The termination of the gypsums is shown as it was 25 years ago in "Acadian Geology." By the constant undermining process going on, the once picturesque prominence has been sadly reduced, and almost destroyed. This is the other corner of the "north side of the southern carboniferous, area of the County. The rocks "consist of conglomerate, breccia, sandstone and limestone, partly covered by a great bed of drift, containing and discharging large boulders on the shore of strikingly characteristic rocks of the Lower Arisaig (Archæan) series of Northumberland Strait." In the limestones there is a cave, where ice can be had at any time. Every variety of gypsum, selenite, fibrous, soft, anhydrous and red, occur in this section. At McIsaac's Brook there is a low lying outcrop of *slates* and *igneous* rocks. This is the extension of the mountain series north of the "Sugar-loaf." Continuing the section, we come to Cribbean's Head. Here is a large exposure of Lower Carboniferous strata containing casts of trees and calamites. This is on the south corner of the northern carboniferous area. Beyond this are Morristown Lakes, obscurity, or rocks without anything of sp cial interest, until we reach Sinclair's Brook. Here are sandstones with *flora*, casts of lepidodendra. Farther on are sandstones, grits and conglomerates. In the sandstones I found scales of *Palæoniscus* and casts of sun-cracks. The conglomerates constitute Cape St. George and its ledges. These rocks belong to the north side of the carboniferous area.

Section III., on Northumberland Strait, from Cape St.

George to Pictou County line.—At the Cape and westward, as far as "Arisaig Township" line, we have conglomerates, with a projecting trap-rock here and there, especially at the *point* of the cape. Beginning at the line, we find exposed on the shore, and up a brook, metamorphic slates of dark colour, with a thin bed of calcite. They seem to be identical with the rocks of the "Sugar-loaf." We shall have occasion to refer to them again. These bring us to what I have, in former Papers, called the "Lower Arisaig" and "Archæan Typical Series." The first rocks of this series are (quartz) 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. Succeeding these are *strata of petrosilex*. These are traversed by *quartzite veins* having mica. After these come steep cliffs of granited diorites, which project into the sea. We have then a bed of ophite and ophicalcite. They extend to the road south of the shore, where it outcrops. To a distance of nearly 2½ miles, there occur diorites, ophites, crystalline limestones and ophicalcites (marbles), hornblende rock, hornblende and albite rock. (*Vide* Polariscopic Notes, No. 1. Paper preceding.) The last is the rock which produced the "boulders in the drift" and on the shore. (*Vide* Section II.) A line connecting this rock with the drift runs S. 20 to 30 E. This is the course of transportation of amygdaloids, &c., from Blomidon. (*Vide* Paper "Glacial Transportation in Nova Scotia and Beyond."—Trans. Institute Natural Science, 1872-73.) Diorites of this series are also traversed by veins of snow-white calcite and quartz. When I discovered these in 1868, I considered them to be of "Laurentian" age. Sir W. E. Logan thought they were of "Quebec" age. Dr. Hunt's opinion coincided with my own. In order to harmonize the two opinions, I have adopted the term "Archæan," which has been applied to the series under consideration in Dana's Manual, last edition, and I thereby designate corresponding rocks. Boulders of these rocks, which first directed my attention to the rocks themselves, succeed. After these are sections of "drift." I regard these as something different from the drift of Section II. While I regard the *latter* as the result of glacial (ice) transportation, I consider water as the agency employed in the production of the *former*. We shall notice this again. At the Cove solid rocks appear. Here we have an isolated patch of Lower Carboniferous conglomerates. Originally this was doubtless connected with the other isolated patch of the same formation which occurs farther west, on the middle and eastern branches of Doctor's Brook. The associated and intervening *igneous* rocks evidently effected a separation. We find similar rocks dividing into parts and branches a band of an older formation, which we shall yet have occasion to notice.

By the igneous rocks the conglomerates have been much hardened and permeated. We therefore infer that the one is of more recent formation than the other. The igneous rocks also appear in a brook a little to the west. Drift then occurs until we reach McNeil's Brook. Here the first strata of the Fossiliferous Silurian series occur. Their second occurrence in the section is at the cove west of Doctor's Brook. From Arisaig Pier to McAra's Brook they then occupy the section. The other rocks in the section, from McNeil's Brook to Arisaig Pier, are a band of metamorphic rocks of Lower Silurian age associated with a great dyke of igneous rocks which extends into the sea, making the shore rocky and dangerous.

At McAra's Brook and beyond are Lower Carboniferous conglomerates, grits and sandstones, with trappean ledges and seemingly intercalary beds, which have been much worn by the sea, frosts and ice. One great projecting mass of amygdaloid to the east of the brook, which was a bold and picturesque feature of the section twenty years ago, now has scarcely a vestige left. The seemingly intercalary beds of trap standing out from the excavated sandstones are very striking. Near the county line, after an alternation of grits, sandstones and slates, there is a considerable bed of Lower Carboniferous limestones resting on slates, marls and a thin bed of limestone having *oolitic* structure, and characteristic Lower Carboniferous fossils. Still farther there are sandstones in which I found, in 1868, two thin beds of *lignite*, with copper and iron sulphide. This was operated for copper. After these are sandstones with concretions. We have reached the end of our coast section.

Arisaig Fossiliferous Series.

Owing to the difficulties connected with correlation, I have subdivided this series alphabetically, at the same time giving their supposed British or American equivalents. (*Vide* "Geology of Arisaig, Nova Scotia," Quarterly Journal of Geological Society, 1864, and Papers in the Transactions of the Nova Scotian Institute of Natural Science.)

A, Mayhill sandstone, Eng.; B, and B', Clinton, Am.; C, and C', Aymestry limestone, Eng.; Niagara limestone, Am.; D, Upper Ludlow, Eng.; E, Ludlow tilestone, Eng.

The fossiliferous strata have the greatest width to south of Arisaig Pier, where the west branch of Doctor's Brook enters the "Arisaig Mountains." The width is about a mile.

In Geology of Antigonish County, Trans. I. N. S., 1875, I have shewn the relation of the fossiliferous series to the two non-fossiliferous of the Arisaig Mountains, thus, by a collation of *four* sections at right angles (south) of the coast section, I will give the results. beginning with McNeil's and McDougall's Mountains. The elevation of one is 1010 feet; of the other 1000.—Bayfield.

Mountain Formations.	ARCHÆAN.	1	Syenitic.	McNeil's Mountain.
	CAMBRIAN. (?)	2	Felsite.	McDougall's "
	....	3	Jaspideous conglomerate	
	....	4	Felsitic.	Summit Rock.
	....	5	*Slates.*	....
	LOWER SILURIAN	6	Argillites, red and grey.	
	Igneous.	7	*Diorites* and Porphyrite.	

Doctor's Brook Formations.

CARBONIFEROUS.			
Igneous.	Trap.		Middle & East Branches of
	Conglomerate.		Doctor's Brook.
	Limestone.		....
SILURIAN.			
"Fossiliferous," Lower		A	wanting ....
		& B	do. ....
	Middle	B'	....
	Upper	C'	....
	....		*Synclinal axis*........
LOWER SILURIAN.		B	....
....		A	....
L. SILURIAN, *Metamorphic.*		a	....
CARBONIFEROUS, *Igneous.*	Trap.		....

REMARKS ON THE ABOVE.

1. Archæan of McNeil's Mountain does not appear to the west of the Mountain. It stretches out northerly towards the shore section so as to approach the Archæan of the section. A singular syenitic porphyrite which occurs in the mountain is also seen in sections about ¾ of a mile to the north; occupying the space that 2, 3, 4, 5 Cambrian ? of McDougall's Mountain would occupy is extended eastward. The latter (Cambrian ?) extends westward beyond the county line.

6. Lower Silurian extends eastward and is parted into two by the associate igneous diorites. One part passes to the north of the 1 Syenitic, terminating, apparently, on the back of the Malignant Cove and Brook, Sugar Loaf (mountain) constituting, with the igneous diorites, the rocks of the mountain. The other part comes to the front in a prominence not far from the road to McNeil's Mountain. After being much shattered, it terminates like a *red vein.* With diorites the same red argillites extend westward, suffering displacement or being faulted and consequently thrown out of line and seems to terminate in a mountain south of Arisaig Pier, unless certain red slates that occur to the south of McAra's Brook on the side of a branch of Bailey's Brook be the termination. This may be the *western* termination

of this much disturbed band, while an outcrop at Malignant Brook to the south of the "Igneous" rocks of the coast section may be its *eastern* termination. Veins of iron ore occur in this series.

Carboniferous series. I have already referred to this isolated series when describing the other isolated conglomerates at Malignant Cove, in the Section III.

We have two fossiliferous silurian series, both of which are very defective. Next the Mountain we have B' and C', A. B., are wanting as well as C. D. and E. Next the shore (N) we have A. B; B.' C. C.' D. E., are wanting. Farther up Doctor's Brook on the rising ground south of Arisaig Pier, we have D. and E., (?) with C possibly underlying as well as B.'

The arrangement of the two series is synclinal.

A. occurs at Doctor's Brook and in Section III. Cove to the Westward. In the latter it is very complete and characteristic, lithologically and palæontologically. The lowest part next sea is argillaceous, the next is arenaceous, the third is argill-arenaceous, and respectively—have fauna, characteristic, 1st—*orthis* and *athyris*; 2nd — *trilobites, cyclonema crebristriata, strophomena corrugata, petraia*; 3rd—*lingula, petraia.*

B. at Doctor's Brook is characteristic in its *Graptolites.* At the Cove in its *lingula* at the Cove at Arisaig Pier, in its *trilobites, corals*, &c.

B' C. C' D., require no *revision.* I would refer to "Geology of Arisaig," Quart. Jour. Geol. &c., 1864. E. at its junction with D. in section is characteristic in its *fauna*, there as well as in McAra's Brook and McAdam's Brook, its litholology is distinctive. The only part of this Typical Series that calls for special *Revision* is A. and B., with associate rocks *(a.)* When my collections were examined by Mr. Salter and Sir R. I. Murchison in 1862, I had not discovered the bed of graptolites in the lower part of B. at Doctor's Brook, consequently these were not taken into consideration when A was correlated with the "May Hill Sandstone." I have no doubt that Sir R. I. Murchison would have considered the *Diprionidean graptolites* as of Lower Silurian age and have regarded B as of that age and consequently A as at least Lower Silurian. In my Paper "On the Geology of Antigonish County," Trans. I. N. S., 1866, we thus read, "Hall's noble work on the 'Canadian Graptolites,' has led me to consider that there is yet something to be done in the correct determination of the equivalency of the 'Arisaig Group,' as the graptolites of B appear to have the *facies* of the graptolites of the 'Hudson River Group,' so that A. B., may be the Arisaig equivalent of this group." Instead, therefore, of beginning with the Upper Silurian age, it may begin with part of the Lower Silurian. During the course of my investigations, I have found it impossible satisfactorily to correlate series of rocks which are evidently identical in their palæontology with A and B, on the supposition that these are of any other than Lower Silurian age. My examination of the Utica formation of Ottawa convinced me that they are equivalent to this. In the beautiful collection of the graptolites from the Isle of Orleans, presented to me by Dr. Hill, of Ottawa, as well as in the fine collection of graptolites from Moffat, Scotland, presented by John Dairon, Esq., Glasgow, I recognize the *facies* of the Doctor's Brook graptolites. I am therefore forced to conclude that B is of Lower Silurian age. The palæontology of A is also of the Utica formation.*

Underlying A is a highly metamorphic and non-fossiliferous band of rocks (a) in contact with trap. These extend (with breaks) from Arisaig Pier to the neighbourhood of McNeil's Brook. They occupy the same relative positions as band No. 6, already described, and have in like manner been much affected by the igneous rocks with which they are associated.

The difference in the lithological character of the two may be accidental. Here we have sandy shale porcellainized and converted into jaspideous rocks, as at Arisaig Pier, Frenchman's Barn (rock) and near McNeil's Brook. These rocks of quartz hardness are associated with others which have a serpentine aspect, and a hardness corresponding. The latter have attracted some

*Professsor Hall, who has examined my collections in the Museum, confirms these views. He considers them to be of Hudson River age. He also considers my Wentworth, I. C. R., series. Cobequid Mts., as of the same age.—Sept. 7. Trans., 1873, p. 354, and Annual Report of Geol. and Nat. History Survey of Canada, 1885. Ells, page 53, Note and Map.

attention on account of their beauty, and supposed adaptability to ornamental purposes. Drs. Hunt and How, and Mr. Louis, Assoc. Royal School of Mines, have examined them. and agreed that they are *hydrous silicates of alumina*, and allied to *agalmatolite*, or Chinese Figure Stone. Constituents of this rock are segregated in veins in the same way as quartz in the jaspideous rock of Arisaig Pier. This band precedes A and B of Hudson River age. How much, we cannot say. The same may be affirmed of Band No. 6. The associated igneous rocks are an extension of those that are found at Malignant Cove, hardening and permeating the conglomerates Section III. They have sometimes been characterized as *augitic*, and at other times as *hornblendic*. Microscopic sections of these are described in a preceding paper.

Section IV., from Northumberland Strait to Guysboro' County line along Meridian Long. 60°.—We begin in the metamorphic Lower Silurian (?) of Section III, one mile west of Livingstone's Cove, and the same distance east of the "Archæan Series." Crossing *a mile* and *two-tenths* we reach the carboniferous of Section II, *i. e.*, the north side of the Basin. The rocks upon which we have entered extend eastward to St. George's Bay. Proceeding westward they skirt and overlie the Archæan series and come up against the Arisaig Mountains. Some of them rise to the side of the Sugar Loaf (mountain). Proceeding seven miles farther we reach the so-called "Morristown Coal Mines." My attention was first directed to this interesting locality in the summer of 1859. A specimen of black shiney bituminous shale, which the discoverer supposed to be *Albertite*, was brought to me in Antigonish for examination. Its highly bituminous character excited interest. I visited the locality and saw a large outcrop of this shale associated with a chocolate-coloured shale, which was equally bituminous. In the latter I found abundance of scales of *Palæoniscus* and various forms of *Lepidodendra*, &c., *vide* Dawson's Fossil Plants of Canada, Geological Survey of Canada. On a subsequent visit I found a section of a cast of a *Sigillaria*. This is from six to ten inches thick and ten inches inches in diameter.

Considerable work has been done in the search for coal under the direction of John Campbell, Esq., of Dartmouth, N. S., who has reported the discovery of coal beds having an aggregate thickness of 28 to 30 feet. Work has been discontinued for many years. Not far from this locality there is a bed of limestone. Advancing further, four miles, we reach the conglomerates of the south side of the basin, at the back of the Antigonish Sugar Loaf. We have noticed the eastern extension of these at McIsaac's Point and Cribbeau's Head, in Section II. The western boundary of the basin are the Arisaig Mountains, as already noticed, and the Antigonish Mountains of Section I. At the back of the former and the beginning of the latter, as the road from Arisaig Pier and Brook descends into Pleasant Valley, Lower Carboniferous limestones are seen outcropping. Fine exposures of conglomerates and coarse grits are seen in Right's River. Black shales outcrop in the "Big Marsh," on the "Old Gulf Road." Sandstones outcrop in all directions, and in Malignant Brook before we reach the cove, and Section III. To the west of this brook hills are seen in the rear of McNeil's Mountain. These are formed of conglomerates belonging to the west side of the basin.

Crossing the mountains of the section, at a distance of half a mile, we find an axial series of igneous rocks. We have already met these at St. George's Bay, Section II. They also outcrop to the west in a bluff on Right's River. The central rock of the "Sugar Loaf" is Archæan (*vide* "Polariscopic Notes"). The rocks of these mountains, with the exception of the igneous rocks, are of Lower Silurian age (?). With the igneous rocks, they are analogous to McLellan's Mountain, Pictou County. Two miles farther we come to their south side, and to the north side of the southern Carboniferous area. A little farther we reach Section I, Line of Railway. Proceeding further (18 miles) we pass through this area with its conglomerate sandstones, gypsums and saltsprings, limestones, ochreous and non-fossiliferous. To the west there are great beds of gypsum. On a small tributary of the Ohio River there is an interesting limestone replete with Lower Carboniferous Brachiopoda. It is one of the two limestones in Nova Scotia's Carboniferous having trilobites, *Phillipsiaan* of interesting Palæozoic race, that abounded at Arisaig in Silurian time. To the west of these is the Archæan formation of the Ohio Mountains, which are common to the counties of Antigonish and Pictou. To the east are the limestones, sandstones, &c., of Upper South River and St. Andrew's, and at Pomquet small *seams of coal* and sandstones, with copper sulphide.

Our section terminates in a Silurian region of more than common interest, having lakes in abundance. The chief of these are Lochaber Lake, Polson's Lake and South River Lake. This is a water shed. The first sends its water to the Atlantic; the two last to Antigonish harbour.

There are two series of rocks about those lakes: 1st—a fossiliferous; 2nd—a metalliferous. The *first* is on the west side of Lochaber Lake. It begins near the head of the lake and extends nearly a mile. The lower part is on the side of the mountain, the upper is on the side of the lake and enters it. The *second* forms an island in the lake, and passes over to the west side. It forms the high lands on the east side, and extends into the County of Guysboro' southward. It extends eastward beyond South River Lake, including Polson's Lake. It bounds and underlies the Carboniferous of the Section from above Lochaber Lake to Upper South River and beyond. The "fossiliferous series" consists of equivalents of A, C', and D, "Arisaig Series." It is defective by the absence of equivalents of B, B', C and E. This was the locality where I first found A. Subsequently it was found at Doctor's Brook, Arisaig. A beautiful internal cast of the characteristic coral *Petraia,(forrestari* Salter.*)* McCoy led to the discovery. The rocks are dark brown in colour, and almost of flinty hardness. All the fossils in it that I have collected are casts, with the exception of *Athyris.* In some cases the calcareous part of *Petraia* has been replaced by quartz. Fossils are by no means numerous, but those that do occur are characteristic. There is not the variety in lithology that we find at Arisaig, neither are the fossils regular in their general mode of occurrence. *Orthis, athyris* and *Petraia* intermingle. The peculiar *cornulite* was by Salter characterized as "trumpet-shaped." The chief rock of the mountain, which rises to a considerable height, is crystalline diorite and intrusiœ? There is nothing intervening between this and A. The D member of the series is seen outcropping on the road and side of the lake. Between this and the outcrops of A are cultivated fields. That C underlies, I know from the rocks of cairns which have produced two large *orthoceratites*, the trilobite *homalomatus* of C horizon, as it appears at Arisaig and elsewhere. D. *strata* have produced the characteristic fossils—Brachiopoda, *Chonetes Nova Scotia*, Hall. *Crania, Acadiensis*, Hall. Trilobite, *Dalmania Logani*, Hall. Here, then, we have A of Hudson River *Lower Silurian*, and C of Aynestry Limestone, or Niagara Limestone, age, and D of Upper Ludlow or Lower Helderberg age—*Upper Silurian.*

We now examine the "Metalliferous Series." I quote the description of this from my Paper—"Geology of Antigonish County." Trans. 1866, page 110: "A very broad band of reddish brown and grey argillaceous slates, which form an island in the lake, extend to Polson's Lake and beyond it. In their strike they extend to the west of Lochaber Lake in the one direction and through South River Lake and the river itself in the other direction; at right angles to the strike they pass into Guysboro' County. On the western side of Lochaber there are magnificent exposures of the brownish red strata in the course of a small brook that runs into the lake. To the south of the brook there is a thick bed of limestones, altered and contorted, which contains blue *fluorite*. This seems to be a carboniferous limestone. Between Lochaber Lake and Polson's Lake the slates contain veins of quartz of considerable thickness, which contain plates of specular iron ore, and at one of the streams that flow into South River, *grey and brownish red slate* is associated with *quartzite*, which contains veins of quartz having colourless crystals (rock crystal) of considerable size and beauty. I also found garnets and crystals of *pyrite* of the beautiful form.—Fig. 4, Dana's Manual, 1878. But these were not found *in situ*. The slates at Polson's Lake are of darker colour than the others."

In these are veins of *calchopyrite*, which are considered to be of economic importance, "Polson's Lake copper mines." There is also a vein of *micaceous oxide of iron*, out of which I had masses at the London Exhibition of 1862. I would observe that these *strata* have been complicated by trap dykes. The position occupied by this series, placed between Fossiliferous D Upper Silurian of Lochaber Lake and the Lower Carboniferous of South River led me to regard it as of Devonian age (in 1866), and to correlate the red strata with E of the Section III., and McAdam's and McAra's Brook. At that time I was not aware of the great band of red and grey strata, No. 6, of the Arisaig mountains, with its disturbing "igneous rocks," with which I now believe it to correspond. I thus place the "Metalliferous Series" *under, Lower Silurian* A of the "Fossiliferous Series," and assign it to an age *prior* to the Hudson River. I am somewhat disposed, on consideration of its lithological and metalliferous character in connection with its "igneous" association, to correlate it with metalliferous rocks of Nictaux and Moose River, in the County of Annapolis.

Pleistocene.

"Drift accumulations abound throughout the county. The transportation of the boulders at Ogden's, Section III, from the Lower Arisaig (Archæan) series of Section III is in the direction S. 30 E. There can be no doubt that this transportation has been effected by glacial action, although no glaciation has been observed in the county. Large masses have been transported from Frenchman's Barn (rock) and Arisaig Pier of the same section to elevated portions of the south."—("Geology of Antigonish County," *Trans., 1875.*)

In my Paper "On Glacial Transportation in Nova Scotia and Beyond," *(Trans., I. N. S., 1883,)* I have referred to this transportation, and especially to the "Archæan" from Section III to Section II, and its course. It corresponds in character with that from the Cobequid Mountains, and in direction with the glaciation which points to Blomidon or Partridge Island as the source of the amygdaloids that are to be found in Halifax and vicinity.

I have also referred to this as a proof that the great glacial movement originated beyond Nova Scotia, and that the coast of Section II was one of its *termini*.

My study of glacial accumulations during the past decade has led me to recognize distinctions in the drift accumulations of this county which I failed to recognize in 1875.

When describing Section III above, I indicated a distinction between the drift of the shore at Malignant Cove and the glacial drift. I connect with this other accumulations to which I referred at the time referred to (1875): "The great drift deposits, which occur in every direction, obscuring the adjacent rocks and rendering the work of exploration often difficult and perplexing. The more prominent are the accumulations on the *hills* that occur in the break that separates the 'Archæan' from the McNeil's Mountain Archæan. About *one* mile from the shore there are gravelly and sandy mounds; gradually they increase in size and numbers until, at a farther distance of *two* miles, the last of the series forms the elevated site of St. Mary's Chapel, which is seen at a distance of *several* miles. In and around the town of Antigonish are similar elevations. My attention was specially directed to these about 20 years ago by the sinking of a well on the side of one on which the 'Old Court House' then stood. After passing through several feet of gravel a bed of clay was struck, which was particularly dry. It was first dark and then light in colour, containing fossil wood, in the centre of which was phosphate of iron of a beautiful blue colour, which might be used as a paint. This is noticed in 'How's Mineralogy of Nova Scotia.' In a section of clays on the side of a small brook, not far from the railway station, I found the same fossil without the phosphate of iron. The fossil was abundant."

These are supposed to be aqueous deposits of Pleistocene age. (Champlain.) Illustrated by a Geological Map of the County.—Scale, *one mile one inch.*—MUSEUM COLLECTIONS.

ART. XII.—PIED, OR LABRADOR, DUCK.—BY ANDREW DOWNS, M. Z. S.

(*Read May* 10, 1886.)

DALHOUSIE College Museum contains a very rare pair of birds, which have now become extinct, the Pied, or Labrador, Duck. They were presented by the Rev. Dr. MacCulloch, of Truro, with his late brother's collection. Attached to them was this label—Family, Anatina; Brisson, Genus; Fulizula; Fulizula Labradora. Lath. Pied Duck. Male and Female. Very rare.

Audubon's description of this bird is given in Vol. 7, page 40, as follows: "Although no birds of this species occurred to me when I was in Labrador, my son, John Woodhouse, and the young friends who accompanied him on the 28th of July, 1833, to Blanc Sablon, found, placed on the top of the low tangled fir bushes, several deserted nests, which, from the report of the English clerk of the fishing establishment there, we learned to belong to the Pied Duck. They had much the appearance of those of the Eider Duck, being very large, formed externally of fir twigs, internally of dried grass, and lined with down. It would thus seem that the Pied Duck breeds earlier than most of its tribe. It is surprising that this species is not mentioned by Dr. Richardson in the Fauna Boreali Americana, as it is a very hardy bird, and is met with along the coasts of Nova Scotia, Maine, and Massachusetts, during the most severe cold of winter. My friend Professor MacCulloch, of Pictou, has procured several in his immediate neighbourhood; and the Honorable Daniel Webster, of Boston, sent me a fine pair killed by himself, on the Vineyard Islands, on the coast of Massachusetts, from which I made the drawing for the plate before you. The female has not, I believe, been hitherto figured; yet the represented was not an old bird."

Wilson's description of this bird, written about 60 years ago, says they were not uncommon then. Of their particular manners, place, or mode of breeding, nothing is known. Latham observes, that a pair in the possession of Sir Joseph Banks were brought from Labrador in 1840. William Winton, of Halifax, and Capt. Waderburn, of the 42nd, Highland Regt., (stationed at Halifax,) each obtained a male in the market. Winton gave his specimen to me; I gave it to George A. Boardman, of St. Stephen, N. B., who had one already among his collection. Mr. Corre, of Boston, gave him $200 for them. I saw a male at the Brown Museum at Liverpool, England; it belonged to the late Earl of Derby's collection. This bird now, like the Dodo and Great Auk, has become extinct. I think the Dalhousie Museum very fortunate in possessing a male and female of this rare duck. I do not know of another female in existence. I hope the MacCulloch collection will be a foundation for a museum in the new college. I have been a close observer of the birds of this province for 63 years, and I have never seen this bird, other than in the specimen given me by Winton, in the flesh. Professor Baird, and other American naturalists, are now trying to obtain all the information they can about this bird.

ART. XIII. — NOVA SCOTIAN ICHTHYOLOGY. — BY REV. D. HONEYMAN, D. C. L., &c., CURATOR OF PROVINCIAL MUSEUM.

(*Read May* 10, 1886.)

I PROPOSE to make a few observations upon certain fishes that have been added to our Museum Collection during last summer (1885.)

Among these are specimens of the black rudder fish, *Palinurus perciformis*, or *Lirus perciformis.* Last session I directed attention to the specimens that I had previously added. At the same time I mentioned that I had only seen two others. I therefore concluded that they were rare fishes. I find that this is not the case. During last summer they were very plentiful in our harbour. Four were brought to me alive. I put them into an aquarium and kept them alive for a few hours. I had no difficulty in identifying them as the black rudder fish, although they were certainly *not black* when living. On the following morning they were dead. Then they were black as they now appear, preserved in alcohol. Other specimens were secured, so that they now do not appear as rare fish. I find from the new work issued by the U. S. Fishery Commission that they were found in abundance—in schools—off our harbour, by G. Brown Goode and his associates when they were at Halifax with the Speedwell in 1877. It attains to the size of 10 to 12 inches "and is excellent eating." Fisheries of the U. S., Vol. I, page 334, 1884.

Silver moon fish.
Selene argentea.

A fish having this name is mentioned and figured in the work just referred to. The young of it is said, in one or two instances to have been found as far north as Halifax, Nova Scotia. The specimen now presented is allied to those referred to. It was found in our harbour. Another was previously received from Mr. Bazeley and was included in my Alcoholic Collection at the Fisheries Exhibition, London, 1883. Still another was brought to me for identification last summer.

The specimen now before us has only a general resemblance to that figured.

1st. The dorsal and ventral fins are very unlike in form.

2nd. Our specimen has a light black spot on either side.

This is on the mesial line formed by the vertebræ, and about half an inch from the tail. The dimensions of our fish :—From snout to point of tail two inches and two-tenths. The body is sub-circular, from snout to tail the length one inch and three-tenths. · Its width is the same. These might be called diameters. It is as "thin as a sixpence." Brown Goode observes : "Their bodies are so thin that they can be dried in the sun without the use of preservatives, without the loss of form or colour." This was the case with our specimen, although it is now in alcohol for better preservation. "They are consequently of no importance for food."

Skipjack. *Scomberesox saurus*, or *stoveri*.

We are well supplied with specimens of this *brilliant* and singular fish. Almost all of them have a like history. They were swimming in our harbor. Boats came in their way and they leaped into the boats and thus were caught. One of which we read an account in a newspaper, alighted in a lady's lap causing considerable excitement. They are classed with flying fishes· "It is sometimes seen to rise to the surface in large schools and fly over a considerable space. When closely pursued by the tunny, bonito or porpoise they spring to the height of several feet, leap over each other in singular confusion and again sink beneath." Its power of springing must be chiefly ascribed to its tail and finlets.

Pilot fish.

Naucrates ductor.

Our specimen was brought to the Museum for identification. It must have been caught near our harbour. It is a pelagic fish. It receives its name from its habit of keeping company with ships and large fish, especially sharks. It is rare in the Western Atlantic and our Museums have very few specimens.

Our specimen is full size, 10 to 11 inches in length. It is elegantly formed and has the usual bands across its body.

They are said to act as pilots for the sharks which they accompany. As one is reported to have led a shark to a hook baited with pork, they may be considered as not always safe pilots

Mackerel, variety (?)

Three other specimens to which I direct your attention have the usual shape and appearance of mackerel so as to be regarded as such. The fisherman who caught these observed a difference and therefore brought them to me for identification.

There are 10 to 13 bands on the sides which run sub-parallel. Their length is from 9 to 10 inches. Their bands seem to be characteristic. I thought at first that they were striped *bonito*. —DeKay.

APPENDIX.

Report by Wm. Gossip, Esq., Delegate to the Royal Society at Ottawa, May, 1883.

(Read Nov. 12, 1883.)

At the Quarterly Ordinary Meeting in April, 1883, of the Nova Scotian Institute of Natural Science, I was chosen a delegate to represent the Institute at the meeting of the Royal Society of Canada, with which we had become affiliated, and which was appointed to be held at Ottawa in the following May. It was a pleasure to me to be the recipient of, and to accept the honor and responsibility; and as a natural sequence it appears that I am expected to furnish some account thereof, so far as my observation extended. I should very much have wished, that what I had to say were of far greater interest; and the only credit I take in the matter is, that it may help to wile away the time in the absence of important papers on subjects of a more scientific nature.

It is certainly a long journey between Halifax, the capital of Nova Scotia, and Ottawa, the Capital of the Dominion, our Institute being the most remote eastwardly of the affiliated Societies. I had never visited the Metropolis, and this was no doubt a chief inducement to undertake it, as it afforded a favorable opportunity of doing the nine hundred and odd miles that intervened. To encourage hesitating travellers, I may state that the journey proved very pleasant at this season, the weather generally delightful, and growing gradually into comfortable summer warmth; and I may also mention, that so far as railway mishaps are concerned, we met with none, and that nothing occurred to mar the pleasure of the excursion, or is likely to occur on any similar occasion, so far at least as careful management of the Intercolonial is implicated.

Professor Allison, Superintendent of Education, and delegate of the Nova Scotia Historical Society, and Professor MacGregor, of Dalhousie College, a member of the Royal Society, and of our Institute, were fellow travellers with myself from Halifax, and a delegate from New Brunswick, on the same errand, met us at Moncton. There was very little railway detention at any of the stations, and we realized a decided improvement since former visits in this direction, at the stations where provision and attendance are furnished,* the quantity and quality of which minister so largely to the comfort and convenience of locomotion.

There is a marked difference in the length and severity of the winter between the Atlantic coast of Nova Scotia and those parts of New Brunswick and Quebec through which we had now to pass. We left no snow behind us, either at Halifax or Truro, and cultivation was fairly progressive, onward and past Amherst to Moncton. But although this was well toward the end of May, the snow had not entirely disappeared further along the route, and very few signs of progressive vegetation were to be seen On the hills around, here and there, and often in secluded places on the railway level, were large patches of snow, first seen at Coal Branch, N. B., most frequent from Campbellton on the Restigouche, and onward on the Metapedia, an affluent of the Restigouche, which, spreading into a large lake-like expanse, still retained its winter covering of ice, although evidently on the point of breaking up. The ice was all gone on our return, eight days later.

We get no more than a passing glimpse of the small townships, or villages, which follow each other in rapid succession on the railway route by the lower St. Lawrence, on to Chaudiere Junction, near to Point Levi. Rimouski, a summer port of the Allan steamship line, is apparently the largest and most important. What can be seen by the railway traveller does not exhibit signs of any modern improvement except the railway itself. The

* Except at Chaudiere Junction.

approaches to some of the stations are picturesque and of much natural beauty. On the sea side is the Gulf, at this season a sombre, sailless, vast expanse of open water. On the land side the ground presents a bare, uncultivated appearance, with a few sheep and cattle grazing, where a human being at this season is a rare appearance. At the stations the scene changes. There the arrival of a train is still an important event, and excites curiosity and talkativeness. The language is French *patois*. The people around the stations are all seeming idlers and French labourers and artizans. The village dwellings look comfortable, but without any pretensions to architectural neatness or design. A further acquaintance might, however, develope something better worth looking at than tavern and other signs and insignia. Almost every station bears the name of a saint, who, from appearances around, does not seem to care much for the growth or prosperity of the place after which he or she is named. To use an expressive and homely Scotch phrase, these holy patrons appear to "have ta'en a scunner" at the whole region. There is, however, a large bid all along the Lower St. Lawrence, in spite of apparent neglect, for saintly protection and intercession in mundane concerns.

On arriving at Chaudiere Junction, near Quebec, the Intercolonial ends, and the Grand Trunk monopolizes passengers and freight onwards, to the serious detriment of our railway line. We arrive at Montreal early Sunday morning, and express some astonishment that so far the attendance of members and delegates from the Lower Provinces is so scant. The day was remarkably hot, and the morning was spent in leisurely visiting Notre Dame, the Quays, and other remarkable localities. In the afternoon Prof. MacGregor, our New Brunswick friend and myself strolled up the mountain to McGill University, or College—the latter being its more popular and familiar appellation. It occupies a conspicuous site, and is a cluster of detached buildings, about which exteriorly there is nothing remarkable, either in architectural design or beauty. The Principal was away at Ottawa. After satisfying, so far as was possible, our curiosity, we climbed the steep stairs back of the house and grounds which formed the handsome residence of the late Sir Hugh Allan, who gave to Canada the noble line of steamships that bear his name, passed on above the reservoirs that regulate the water supply of the city, ascending in this way to the summit of the mountain, from which spreads in every direction the most enchanting and extensive view of the country around. At our feet in Sunday quietude and silence lay the City of Montreal, every tower and spire (Notre Dame conspicuous) easily distinguishable. Next the noble river with its wealth of shipping at the quays, the Victoria Bridge, its chief feature,—and then the country beyond and around on all sides, studded with villages and farms—the whole embracing a circumference of fifty miles or more. There were not many on this hot day who had achieved so elevated a position—but the scene well repaid the exertion. The mountain with its palatial residences, religious houses, and sylvan scenery, presents of itself a richly picturesque appearance. At this height and so early in the season, indicatory of the rapidity with which spring or summer succeeds the intensity of winter's cold around Montreal, the ground was covered with quite a luxuriant growth of herbaceous plants and wild flowers in full bloom and rare beauty, not having, so far as we are aware, their counterpart in Nova Scotia (of which our New Brunswick botanical friend took particular notice), completing the beauty of the glorious prospect. We could have remained for hours in admiration of the lovely panorama, and its natural and artificial beauties, but a gathering rain obliged a reluctant retreat, and highly delighted as we had been, we descended the mountain, but at a much more rapid pace than we had taken to gain the summit, somewhat tired withal, and glad to arrive as quickly as possible at the shelter of our hotel.

The train left for Ottawa, 120 miles, on Monday morning, which was reached by 12 noon. The country everywhere had thrown off its winter garb. There were no lingering patches of ice or snow. Wild flowers, skirting the track, met us at intervals, this time of a bright yellow colour, clustering like primroses. Our friend, the sole New Brunswick botanical delegate, spoke of them as not being indigenous either in that Province or Nova

Scotia. Certainly the season here is at least a full fortnight in advance of all the country between Montreal and the Lower Provinces. The villages from St. Polycarp onward, were quite a contrast in beneficence of their saints, to those on the Gulf shore below Quebec, more picturesque and prosperous, especially in the vicinity of streams, the characteristics of each decidedly Canadian, but becoming more and more of a British type, the nigher we approached the metropolis—the land low and the soil rich. Lumber was apparently the prevailing mercantile commodity, and numerous piles attested its value. An hour improved appearances in every respect. We came in view of the noble Ottawa, much pleased with the morning's ride, and prepared for a closer acquaintance with the Metropolis.

Ottawa is a city of magnificent distances, a fact easily realized in passing from the railway terminus to the hotel. Many of the streets seemed to be more than a mile in length, crossing at right angles, wide and spacious. It is to be hoped they are all sufficiently high above the river to prevent danger from floods. The Parliament Buildings, erected on a gentle elevation, imposing in the style of their architecture, are conspicuous objects, in every way creditable to the youthful energy and ambition of the Dominion, and crown the city with an air of regal splendor. Ottawa is a Capital of large pretensions, the site and plan being chosen and approved by Her Majesty Queen Victoria, as a central position in a beautiful country, removed from the American frontier, and easily defended in the event of war. Rideau Hall, at the distance of a mile from the Parliament Buildings, the palace of the Governor-General, is quite insignificant in its contrast with the Parliament Buildings, and ought ere long to give place to a structure more in keeping with the Viceroyalty of a Dominion which spans the British American Continent, and east and west is bounded by the Atlantic and Pacific oceans.

No one can be mistaken who visits Ottawa and its environs, as to its principal industrial staple. The immense piles of sawn timber, here, there and everywhere, strike the beholder with amazement. It was remarked by several, as by the writer, that they never saw anything like it. Yet this was not the busy season, and of what that may be, both on the river and the shore, we could form only a vague conception. Withal an opinion is broached by some residents, not however general, that Ottawa is unlikely ever to become a flourishing Capital. They probably expected a large and sudden development on its assuming that character, or it may be based upon correct and continued observation. As a stranger, however, we could see no reason for it, and in all respects it is unfounded by any comparison with maritime progress. The immensity of the staple, the bustle of business, the din of steam machinery incessantly at work, the cabs and busses continually running to and fro full of passengers, several first-class hotels, the customers frequenting various handsome retail stores contiguous to the parliament houses, large churches of various denominations, the activity everywhere displayed, all tended to disprove the grumbling element.

Ottawa is delightfully situated, but a large area remains to be built upon. Its geological foundation is sure, being the Trenton limestone formation, which, comparatively in the ascending series, is not much above the lowest non-fossiliferous rocks that first solidified into the crust of the globe. The displacements and contortions of thousands of ages, the disruptions and denudations of overlying strata, as numerous periods have passed over them, have made the country what it is, an invaluable legacy, bequeathed to the energies of the most energetic branch of the human family, to perfect the beneficent designs of an Omnipotent Creator. The natural scenery, in a limited circumference, is all that can be desired either for walks or drives. It is more varied than that of our own Halifax, but can hardly be surpassed, which is saying a good deal for its beauty; the sky, at all events, at this season is of a paler blue than with us.

Hull, a township or district on the opposite side of the river, which we did not visit, is crossed to by a ferry, looked pretty in the distance, and is an attractive outskirt of the Capital. At a short walk in another direction are the Falls of the Rideau and the timber slides, inviting to passive courage. Canals, having numerous locks, pierce the city and communicate with the rivers. The extensive machinery which regulates the water supply, is well worthy a visit. There are also the Parliament Buildings, with the Senate and Commons Chambers, the really splendid Legislative Library, the Museum and the Patent Office, which represents in great and astonishing variety—rather crowded, however,—the inventive genius of the Dominion. In a building in the vicinity, used as a temple of art, some pictures of high merit were recognized, some of which had graced the late exhibition at Halifax, held under the auspices of the Governor-General. Strangers should see all these and everything. In fact there is nothing to disappoint, but enough to gratify curiosity and taste in all the surroundings of Ottawa, which alone of themselves are amply sufficient to make a visit to the Capital of the Dominion highly agreeable.

Ottawa is not gone over in a day; but the remainder of Monday was spent in the gallery of the Commons Chamber of the Parliament, a large, handsome and commodious hall, where the Liberal-Conservative and Grit elements sat facing each other, Sir John and Sir Charles on one side, and confronting them Mr. Blake and his following. Apparently they were seeking explanations one of the other, preparatory to winding up the business of the session, which occupied both parties far into the night. We left long before the adjournment.

On Tuesday the Royal Society met in the Parliament Building to be organized, Dr. Dawson, the President, in the chair. Mr. Bourinot, the Secretary, read the minutes. The President addressed the meeting. The roll was called, and a large number from various parts of the Dominion, members and delegates, answered to their names. The Society was divided into separate sections, which were referred to their several places of meeting. I was consigned to the Natural Science section, which was also where the general business was transacted. Several interesting papers were read, having reference to the Zoology of the North-West. As I was anxious to find anything that would tend to settle the question, whether any two species were common alike to the eastern and western hemispheres, I ventured to ask of the gentlemen who had contributed the papers in which badgers and earthworms were mentioned, if they were of similar species to the badgers of England and the earthworms of our fields and gardens, and was very kindly informed that the badgers were precisely similar to those of England, with the same habits, only much larger; also that the earthworms were similar to those of our fields and gardens. I remain still in doubt about this latter conclusion. It is certain, I believe, that our anglers never find earthworms in the virgin soil of the woods, but are obliged to take such bait with them. The question may still be one of some zoological importance. A member from New Brunswick laid before the Section a number of well-preserved Indian relics, —axes, chisels, pipes, spear and arrow heads, &c., all stone implements, which had been found in that Province. They were of the Algonkin type of ancient aboriginal relics, and it was presumed were Micmac weapons and utensils. From the absence of pottery in this and other instances noted, it was supposed that the more eastern tribes did not possess the art of making it. Being called upon, I was enabled to contradict this, as in one of the field excursions of the Halifax Institute, with the express object of opening an ancient refuse heap at St. Margaret's Bay and examining its contents, several pieces of broken pottery were found, the remains of dish or bowl, the edges or rims ornamented with small bead-like cubes of iron pyrites, inserted when the clay was soft and compressible. In general the exhibits were very clean, as though carefully washed, and there were present implements of black stone, the like of which I had never before seen, although there are a great variety of Micmac implements in the Halifax museum. They could scarcely be classed entirely as Micmac. Some thought they might be Milicete or Penobscot, or partly of a type more southern still. It was an interesting collection, very appropriate as a memento of the very recent age of stone in America, when man on this portion of the continent had made no progress beyond the rudest appliances to provide for his immediate wants.

It was intimated by direction of the President, that the delegates would meet next day at the Section of Natural Science, to present reports from the various affiliated Societies. Also, that the Governor-General and Princess Louise would hold a reception of the Society in the Senate Chamber, at 1 p. m., and then the meeting adjourned.

Wednesday the Society again assembled, and reports were read by the delegates. These consisted for the most part of short papers, giving some account of the design and work of the several bodies. Mr. Allison, delegate from the Halifax Historical Society, made some pertinent verbal observations of its objects and progress, and spoke of the importance in connection with it, of preserving a particular record of the stirring events which had taken place in the early period of our provincial history. When called upon I was obliged to state that, owing to some misapprehension, for which I could not then satisfactorily account, I had no report. I had telegraphed to Halifax for the information I sought, in order to be ready for the occasion, but had not obtained it. I had previously prepared a Paper on the work of our Institute, which might be read as a report, which I then submitted for approval and handed to the Secretary. Shortly thereafter the Society adjourned to the Senate Chamber, and in about half an hour the Princess Louise arrived with the Governor-General and suite, who took their places around the throne. A French Canadian member of the Literary Section, with powerful voice and strong emphasis, delivered an original poem in the French language, "the poet's eye in a fine frenzy rolling." A number of presentations were then made, but a scarcely mannerly assemblage pressing before the Society and usurping its place, the Princess soon retired.

The sitting was resumed in the afternoon, when I was informed, through the Secretary of the Section, that the remaining time at their disposal was precious, and that it would be advisable to reduce the length of my paper, which he thought a very good one. This I immediately set about, and accomplished to his satisfaction. In the meantime a rather exciting geological discussion had taken place on a Paper read by Dr. Sterry Hunt. That gentleman contended that in the Thunder Bay section, or district, he had recognized a new geological formation, unconformable and of considerable thickness and extent, between the Huron and Laurentian strata—a statement stoutly opposed by

Dr. Selwyn, a gentleman intimately acquainted with the region, who said that it could not be—that there was not sufficient evidence for it, and that Dr. Hunt must be wrong. Both gentlemen were very positive in the views they entertained, which were supported by others of the meeting, and the discussion may be said to have been a drawn battle, to be decided by more positive evidence in the future. So far as I could ascertain of the views of members around, there appeared to be a rather general disinclination to the admission, under present data, of a new member of the geological series; and an opinion that Dr. Hunt and others may have mistaken for it an upper member of the Laurentian. On this afternoon the Governor-General paid a visit to the Section, and listened to an excellent Paper from Professor McCoun, on the plants of the North-West, with which His Excellency expressed his gratification, and soon after retired.

The President then gave notice that such papers as had not received attention might be read as reports on the following morning, which certainly included mine, and the Section adjourned.

Thursday was the Queen's Birthday. The weather, which for the three previous days had been an incessant rain, and very disagreeable, suddenly changed to clear and lovely sunshine, befitting the occasion. Bands of music paraded the streets at an early hour in the morning, and the day was celebrated as a public holiday. The Society, however, met as usual, eager to finish its business. Several reports from distant Societies had come to hand since the last adjournment, and it was decided that they should be read although out of time. This was hardly fair to my report, which was in no way objectionable, and should have had precedence. There could be no reasonable excuse, I thought, for the omission, although the report was that of a delegate. I therefore asked for its reading on the ground of the notice of the President at the adjournment last evening. But time was pressing. The prorogation of Parliament, the presentation to the Princess, and the Governor-General's Lunch at Rideau Hall, to which all were invited, were considerations far too important to be affected by minor details. Mr. Sandford Fleming and Prof.

MacGregor, both members of our Halifax Institute, recommended me not to press the reading. I acquiesced, and the meeting adjourned. I brought away my Paper, which, as I thought it fit to be read before the Royal Society, may not be an inappropriate Paper for the affiliated Nova Scotian Institute. I leave it with you. The Society met again in the afternoon when the celebrations had terminated. They elected Mr. Chaveau, a talented French Canadian gentleman, President for the ensuing year, and Dr. Sterry Hunt, an eminent geologist, Vice-President, and then the session of the Royal Society concluded its labours with the usual formalities.

It only remains to notice the gracious reception accorded to the members and delegates of the Royal Society by His Excellency the Governor-General and Her Royal Highness the Princess Louise, at Rideau Hall. The Society had been specially invited to a Lunch and Garden Party, on the anniversary of the birthday of Her Majesty Queen Victoria, mother of the Princess, and we need hardly say that the gracious invitation was generally accepted. The Presentation took place in the Hall set apart for the occasion. There were present Sir Charles Tupper and several members of the Government and of Parliament, and other distinguished persons. That funny fellow Mark Twain was there as a guest of His Excellency. Each member and delegate was introduced by Dr. Dawson, President of the Royal Society, and shook hands with the Governor-General and Her Royal Highness, both of whom looked in the best of health and in excellent good humor. The party were then ushered into the dining hall, which was soon filled with guests. His Excellency presided. An hour was spent in agreeable converse, and ample discussion of the viands and wines lavishly prepared for the occasion. Only two toasts were proposed. His Excellency gave The health of the Queen of England, which was quietly but enthusiastically responded to ; then that of the President of the United States, which would have been responded to by Mark Twain, but was otherwise arranged. After the lunch the party visited His Excellency's Museum of curiosities, where were exhibited Zulu rifles, on one of which at least "the blood still stuck to the *stock*," spears, assegais, &c. A number of unique and valuable Indian curiosities were displayed, consisting of sumptuous Indian gala robes and dresses, spears, bows and arrows, collected in the North West during His Excellency's visit to that part of the Dominion. After deliberate inspection of these, His Excellency led the way to the Garden Party, of which the Princess did all the honors with the gracious affability she well knows how to assume. A cricket match in an adjoining field also drew the attention of the party, at the conclusion of which the festivities ended.

It would be premature to hazard a decided opinion on the permanence or otherwise of the Royal Society. Time must decide that question, which is an important one. The British Association pays a visit to Canada next year, and a good deal will depend on the action then taken. If the people of the Dominion can be induced, even comparatively, to take a similar interest in scientific pursuits to that which is manifested in England, there can be no doubt of the result. The Dominion Government, we dare say, will do its part upon the occasion. We fear, however, that neither numbers, nor wealth, nor inclination, nor time, can be sufficiently engaged to secure the immediate success of the Royal Society, although we earnestly hope it may be otherwise. There are some defects also in its organization, in that its numbers are unwisely limited. So far, however, the attempt is highly laudable, and ought to inspire the earnest zeal in its behalf of every lover of his country seeking its advancement among the nations.

(Re-printed from the Proceedings of the Geological Association, London.)

Glacial Distribution in Canada.

By the Rev. D. Honeyman, D.C.L., F.R.S.C., Hon. Memb.

1. *Triassic Amygdaloids (A) and Carboniferous Boulders.*— The author's investigations of glacial distribution in Canada began in 1873. On the beach at Cow Bay, east of Halifax Harbour, Nova Scotia, abundance of amygdaloid boulders were seen. These were at once referred to Cape Blomidon, whose rocks are Triassic basalts, amygdaloids, &c. Blomidon, or some part of its rock extension to Five Islands, N. E., and Brier Island, is the only series of rocks in Eastern Canada which could produce these boulders. Red Head, on the east side of Cow Bay, was seen to be the secondary source of the boulders. From this bluff of drift large and small amygdaloid boulders had just fallen. Here an agate was found, and specimens of Blomidon zeolites. Great masses of Cambrian quartzites had recently fallen, and were still imbedded in drift. These were strikingly grooved and striated on varying sides. Rock surfaces had also been observed on our way showing glaciation. Action and reaction were thus suggested. A copy of the Admiralty Chart, on which Blomidon and Halifax both appear, was procured. A very fine and extensive glaciated expanse of Cambrian argillites at Pleasant Park, Halifax Harbour, was located on this map. The direction of the glaciation and grooves, S. 20 E., N. 20 W., was extended, and found to pass in front of Blomidon. Deep grooves were seen having a south-east termination, where the graver had evidently been fractured by coming in contact with hard edges of tilted and crumpled strata, the grooves terminating in small *striæ*, running in different directions and disappearing. These show that the glaciating agency had evidently come from the N. W., the direction of Blomidon.

An interesting problem was thus presented for solution. I found similar boulders occurring in abundance on the Atlantic shore, from Point Pleasant, Halifax Harbour, west of Cow Bay, to Three Fathom Harbour, east of it. Associated with these were Lower Carboniferous Limestone boulders with fossils *(Brachiopoda, &c.,)* and boulders with Carboniferous plants, such as *Stigmaria, Lepidodendra,* and *Calamites,* from the beds intervening between Blomidon and the coast. This is very interesting, as showing that the transporting agency levied upon every formation over which it passed. An iceberg could not do this: a glacier could. The distance between Blomidon and Cow Bay is 62 miles. Drift accumulations and drift sections occurring on the lines of railway, especially the Windsor and Annapolis Railway, were all examined, and the amygdaloid boulders were found to increase in numbers as we approached their source.

2. *Triassic Amygdaloids* (*B*).—From a distance of 45 miles west of Blomidon, amygdaloids have also been transported to the Atlantic coast. In the drift cuttings of the Nictaux and Atlantic Railway, on the side of the Nictaux River, I found amygdaloids of the same character as those of Blomidon. I also observed a fine outcrop of Lower Silurian argillities on the north of Cleveland Mountain, on the south side of the Annapolis Valley. North Mountain, a continuation of the Blomidon range, is on the north side of the valley. The position of the glaciated rock-surface is at a height corresponding with the general elevation of North Mountain, 600 feet. This is the most northerly glacier found in Nova Scotia. The Triassic sandstones, which are undoubtedly in the valley, although they cannot be seen, must have filled the interval between the two mountain ranges in Pre-glacial times to account for the glaciation indicated and the passage of the amygdaloids. In my collection I have a large amygdaloid boulder which was picked up at Lunenburg, the Atlantic terminus. The Nictaux and Lahave Rivers, which nearly meet at their sources, are approximately in the line of transport, as are also a long chain of lakes. The Nictaux River flows northerly into the Annapolis River in the valley: the Lahave River, southerly, into the Atlantic. The Nictaux and Atlantic Railway runs generally in the same course.

3. *Archæan Gneisses, &c.* (*A.*)—On the north of Blomidon, at a distance of 13 miles, is the south side of the Archæan rocks of the Cobequid Mountains. This range extends from Cape Chignecto, on the Bay of Fundy, through Nova Scotia, to a distance of ninety miles. Boulders have been transported from it in a direction, indicated by glaciation, S. 20 E. mag., the same as the Blomidon amygdaloids. These are spread broadcast in the eastern part of Colchester County and the County of Hants, which bound Halifax County on the north. (*Vide* papers in the "Transactions of the Nova Scotian Institute of Natural Science," 1881–2 and 1882–3). In Halifax County they are largely intercepted by a great belt of granite, which is generally six miles wide, extending from Major's Lake, near Waverley Gold Mines, on the west, to Ship Harbour on the east. Some of the Cobequid boulders reach the shore along the course of the Musquodoboit River, and other breaks in the granite belt, *i. e.*, a granitic transportation takes the place of the other, the boulders of the latter having to be closely searched for among the abounding granite boulders at Musquodoboit Harbour and Clam Bay. At the Waverley (W.) end of the granites, or rather at the end of another granite occurring farther north, which seems to come into a line of it, the Cobequid boulders have found a better passage. Their course became changed to S. W., as is seen by the glaciation of the Cambrian argillites at the Intercolonial Railway, near the Grand Lake. This brings them into Bedford Basin, Halifax Harbour, and the City. The Archæan transportation thus unites with the Triassic, so as to predominate over the latter. The combined transportation then deposits the accumulations at Laurence Town, Cow Bay, and at Eastern Passage, Halifax Harbour, at Thrum Cap, McNab's Island, and George's Island in the Harbour, at Point Pleasant, Fort Massey, Fort George, Observatory Hill, H. M. Dockyard, and Fort Needham, and at Navy Island, Bedford Basin ('Trans.,' 1881–2.)

In like manner the great and extensive granites (B) on the west side of Halifax Harbour, in their extension toward Blomidon, at Bedford, intercept a part of the amygdaloids, and in turn are transported towards the Atlantic. Some of these boulders become huge *roches perchés e.g.*, the great "Rocking Stone" of Spryfield.

3. *Archæan Gneisses, &c. (B)*.—Eight miles from the north-east termination of Nova Scotia, near Cape St. George, Antigonish County, on the Northumberland Strait, is the "Typical Archæan Series," which I first recognized in 1866. Dana, in his 'Manual of Geology' (1674), gave it the name "Archæan," which I have since adopted. I found the boulders of the series, on the shore and in the drift, at Ogden's, Gypsum Bluff, St. George's Bay. The largest boulders on the shore are very striking in appearance. It is more than twenty years since I first noticed them. It was then supposed that they had been carried from the coast of Labrador. The identical rock was easily recognized among the series on the Northumberland Strait, associated with crystalline limestones and serpentines. There is no apparent glaciation, but a line drawn on the Admiralty chart from the rock *in situ* to the drift-section of St. George's Bay coincides exactly with the line of Blomidon transportation.

Fiords.—Looking at our chart, we observe that the Strait of Canso, which separates Nova Scotia and Cape Breton, and which enters St. George's Bay, runs parallel with our last Archæan transportation line. All the harbours of Nova Scotia, from the Strait of Canso to Ship Harbour, where the great granite belt ends, are approximately parallel. From Ship Harbour to Halifax Harbour, the harbours conform with the changed direction of transportation. Halifax Harbour, Bedford Basin, and the Estuary of the Avon are approximately in the line of the Blomidon amygdaloid transportation, and are only about eight miles apart.

Remarks.—The Archæan of Northumberland Strait lies (14') north of the Archæan of the Cobequids. The transportation could not originate there; we must, therefore, look beyond Nova Scotia. This consideration led me to refer to Logan's 'Geology of Canada,' (1863). Examining the Tables of Glaciation Grooves, I found that the S. E. courses to the N. E., N., and N. W. of Nova Scotia, prevailing over the S. W. in the proportion of two to one. The Nova Scotia transportation is, therefore, a continuation of that of Quebec Province, and my investigations have given it an Atlantic terminus.

Ottawa Gneisses (*C.*)—On a visit to Ottawa, in May, 1882, I observed massive boulders of Archæan gneisses in a number of places. At the Rifle Ranges I examined them more particularly. Some of the gneisses were beautifully banded, others of them contained abundance of magnetite. In Sir W. Logan's table, the course of the glacial grooves at Rideau River, Stegman's Rapids, and also at Barrack Hill, is S. 45 E., true meridian. Defining this course on Vennor's Map, I found that a N. 45 W. extension passed between the Hull and Laycock Magnetite Iron Mines. According to the same table, at Hull the glacial grooves run S. 45 E. This is certainly a satisfactory coincidence.

Kingston Gneisses (*D*) *Archæan.*—When I was at the Dominion Exhibition at Kingston, in September, 1882, my attention was directed to the large quantity of boulders which lay about the exhibition grounds. The greater part of them corresponded with the Ottawa boulders, with the exception of the magnetic ones, and were consequently Archæan. One boulder was of Trenton Limestone, and was glaciated. Looking for glaciation *in situ*, I found it on the limestones at the edge of the water near the entrance to the Royal Military College. The course of the grooves was S. 54 W. magnetic. The direction observed by Sir W. E. Logan was S. 45 W., true meridian, while "other grooves run S. 85 E." Trenton Limestone is the formation on which Kingston is built, and of which it is built. Hence it is called "the Limestone City." In the approach to it, near the Rideau Canal, the Archæan (Laurentian) is seen with the Trenton Limestone lying directly upon it, in the same way as on the Railway from Montreal to Ottawa, near the latter. We have now reached long. 76° 25' to 29', and lat. 44° 14' to 19'. In long. 80° 54', lat. 44° 28', is the last of the south-easterly grooves (S. 5 E.), according to Logan. In long. 79° 33', lat. 46° 10', is Nipissing Lake. Here, and beyond all grooves are, therefore, S. W. Lake Temiscamang, long. 79° 26' to 30', lat. 47° 7' to 36', has glaciation generally S. E. This is the region of divergence as well as of watershed.

Rimouski Gneisses (*E*) *Archæan*—At the Railway Station on both sides of the railway, I found and examined Archæan boulders of large size. Some of these were granitic gneisses identical with those that I found at Ottawa and Kingston. The only place where the rocks of this kind are to be found *in situ* near Rimouski is on the opposite side of the River St. Laurence, which is here 20 miles wide. Glaciation was found by Sir W. E. Logan at Kempt Road, near Metapedia Lake, long. 67° 43', lat. 48°. Its course was S. 80 E.

I would observe that the lines of glaciation of Pleasant Park, Halifax, extended in a northerly direction on our Admiralty chart, pass through Rimouski at a distance of 310 miles.

Our field of observation thus extends from Cape George, Nova Scotia, long. 62° to Kingston, Canada, long. 76° 25' to 29', *i.e.* through 14° 25' long., and from Halifax, lat. 44° 34', to Rimouski, lat. 46° 26', *i.e* through 3° 52' lat.

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