PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. II. 1866-7. PART I.

CONTENTS.

HALIFAX, NOVA SCOTIA:
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PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME II. PART I.

Anniversary Meeting, October, 3, 1866.

In accordance with the Bye-Laws of the Institute, the Anniversary Meeting was held on Wednesday, October 3, 1866, at 8 p.m., when the following gentlemen were elected office bearers for the ensuing year :—

President.—J. M. Jones, F. L. S.

Vice-Presidents.—Lieut.-Col. C. Hardy, R. A., J. Bernard Gilpin, M. D.

Treasurer.—Capt. Lyttleton.

Secretary.—William Gossip.

Council.—Colonel W. J. Myers, F. M. S., J. R. DeWolf, M. D., *Edin.*, Jos. Bell, J. H. Duvar, W. C. Silver, P. S. Hamilton, Capt. King, Royal Artillery, Professor Lawson, L. L. D.

Ordinary Meeting, Nov. 5, 1866.

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

Dr. J. B. Gilpin, *(Vice-President)*, exhibited a very carefully prepared drawing of a large sized specimen of the Brook Trout *(Salmo fontinalis)* in nuptial tint of bright vermillion beneath, and sides spotted of the same colour. The specimen from which the sketch was taken, had been procured at River Bank, Preston, by W. C. Silver, Esq.

Dr. Gilpin next read a paper "*On Nova Scotian Mammals*—Part 3," which treated of the *Mustelidæ* known to the Province. Several life-like drawings illustrating the figure and habits of the different species, accompanied the paper. *(See Transactions.)*

The President read a paper by Edgcumb Chevallier, Esq., of H. M. Naval Yard, Pembroke, entitled, "*Suggestions on the importance of continuous Meteorological Observations.*" *(See Appendix.)*

Mr. J. D. Nash, exhibited a specimen of Sulphur Ore from Cape Breton, the purity of which was tested and proved by experiments.

Mr. J. R. Willis exhibited two phials containing samples of chalky mud brought up by the lead from a depth of two miles, during the sounding process for the laying of the Atlantic Cable. The substance partook somewhat of the character of the Bermuda chalk mud, though of darker colour, and appeared to be perfectly free from siliceous matter.

ORDINARY MEETING, DEC. 3, 1866.

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

Lieut.-Col. HARDY, R. A., read a paper "*On the Beaver in Nova Scotia.*" (*See Transactions.*) A model of a beaver house and drawings of beaver dams, tended to illustrate this very interesting paper. The model and drawings, at the request of the Nova Scotian Commissioners, were allowed by Colonel Hardy to form part of the collection forwarded by the Colony to the Paris Exhibition, where they attracted considerable attention.

A piece of wood of large diameter, cut through by Beavers, which had been procured in Shelburne Co., by R. G. HALIBURTON, Esq., F. S. A., was exhibited.

The Rev'd. D. HONEYMAN, F. G. S., read a paper "*On the Geology of Gay's River Gold Fields.*" (*See Transactions.*)

The PRESIDENT exhibited several species of Nova Scotian and Bermudian sponges, and explained the mode of growth of this interesting class, particularly those of the Bermudian waters.

ORDINARY MEETING, JAN. 7, 1867.

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

The Rev'd. D. HONEYMAN, F. G. S., read a paper "*On the Geological Features of the Londonderry Iron Mines.*" (*See Transactions.*)

The conversation which followed the reading of this paper, had reference to the various kinds of iron ores found in Nova Scotia, and several localities were mentioned where they existed in large quantities.

Dr. HOW, Professor of Chemistry, King's College, Windsor, read a paper entitled, "*A Descriptive Catalogue of the Mineralogical Collection forwarded to the Paris Exhibition.*" (*See Transactions.*)

ORDINARY MEETING, FEB. 4, 1867.

Mr. P. S. HAMILTON, Chief Commissioner of Mines, read a paper "*On the Tides of the Bay of Fundy.*" (*See Transactions.*)

In the discussion which followed several members alluded to the gradual filling up of harbours and inlets by sand or alluvial mud, in different parts of the Province.

Professor LAWSON, of Dalhousie College, read a paper "*On the Trichina,*" and exhibited specimens of internal parasites. (*See Transactions.*)

A member instanced the case of the Porcupine of Nova Scotia, (*Hystrix dorsata,* Lin.) which he had opened and found to have its stomach filled with a large sized species of *Tænia.*

The PRESIDENT read a paper entitled "*A Fortnight in the Backwoods of Shelburne and Weymouth.*" (*See Transactions.*)

ORDINARY MEETING, MARCH 4, 1867.

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

Colonel W. J. MYERS, F. M. S., read a paper entitled "*Notes on the Weather at Halifax, Nova Scotia, during* 1866." (*See Transactions.*)

In the discussion which ensued, the PRESIDENT remarked the scarcity of some kinds of insects, particularly grasshoppers, during the past summer, and attributed the circumstance to the severity of the preceding winter. The various species of butterflies and moths which in ordinary seasons were generally abundant, had been extremely

rare. The different warblers and other insectivorous migratory birds had also been scarce.

Professor LAWSON had also noticed the absence of grasshoppers last summer, about his residence at Sackville, and stated that during the previous summer, (1865,) they were so numerous in one of his wheat fields that he had to put in a flock of turkeys to destroy the pests, which they did effectually.

Mr. W. C. SILVER considered that some other cause than that of severe cold, must have affected the insects, for in New Brunswick and Canada, where the cold was much greater than ours every year, the insects named were always abundant.

The SECRETARY, believed that severe cold might affect some insects more than others, and although many insects of various kinds had been killed during the last winter, some had evidently escaped, for his crop of beans, as well as those of others in the city, had been entirely destroyed by a species of small caterpillar.

The PRESIDENT in answer to Mr. SILVER's query stated that he observed it was only in severe winters when little snow fell, that the great mortality amongst insects occurred. It was not so much the severe frost, as the absence of snow to cover the earth to a depth sufficient to protect from its influence the larvæ of certain species, that caused their destruction. In Canada and New Brunswick much more snow fell, and remained a longer time than in Nova Scotia, and therefore the insects, although the cold was much greater in the former Provinces, would have greater protection.

The Rev'd. JOHN AMBROSE, Rector of St. Margaret's Bay, read a paper entitled, "*Some Observations on the Fishing Grounds and Fish of St. Margaret's Bay.* (*See Transactions.*)

Several Members took part in the discussion which ensued, especial reference being made to the change of colour in fish, which colours were stated generally to harmonize with those of surrounding objects. They were considered by some to emanate from the nervous system. Allusion was also made to a kind of natural photography which took place at times when fish rested perfectly still, and the rays of the sun reflected some contiguous object upon their sides.

Capt. L'ESTRANGE, R. A., had observed that large animals, even such as the Cariboo (*Tarandus hastalis*, Lin.) partook at times of the colour of the rocks and ground they frequent; while at the Mauritius he had frequently noticed that the tropical fishes partook of the gaudy colours of the animal and vegetable habitants of the coral reefs.

Mr. W. C. SILVER had noticed that Brook Trout, when dying, would take the colour of the object on which they rested.

Mr. P. S. HAMILTON, (Chief Commissioner of Mines,) read a paper "*On supposed submerged Forests in Cumberland Basin.*"

Mr. CAMPBELL mentioned some interesting facts in connection with the locality reviewed by Mr. Hamilton, more especially referable to the glacial period.

VICE-PRESIDENT GILPIN stated that an extensive land slip took place several years ago, near Annapolis, which presented a similar appearance to those mentioned by Mr. Hamilton.

The SECRETARY considered that changes were evidently taking place on our Atlantic coast, for the Eastern Passage had of late years rapidly filled up with sand. So had Cole Harbour, but whether the land was being submerged, or the sea forcing fresh matter to the land, it was hard to say. Oysters, judging from the quantity of shells found in the *Kjöekkenmoedding* on the shore, had been abundant in Cole Harbour in remote times, but for the last eighty years or more, not one had been known

about the place, which proved that some change must have taken place, rendering the shores unsuitable to the propagation of those mollusks.

Mr. W. D. O'Brien, who was introduced by Professor Lawson, described his impression of animal life at high altitudes on European mountains, from which it appeared that an almost total absence of all kinds of animals, birds and insects, occurred above a certain height.

Ordinary Meeting, April 1, 1867.

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

Mr. J. Outram read a paper "*On Sugar, its chemical composition, combinations, and products.*"

After the reading of the paper, Dr. Jennings made some remarks upon the disease called Diabetes, in connection with the production of sugar in the human system.

Vice-President Gilpin read a paper "*On the Food Fishes of Nova Scotia.*—No. IV." *(See Transactions.)*

Ordinary Meeting, May 6, 1867.

J. B. Gilpin, *Vice-President, in the Chair.*

R. G. Haliburton, F. S. A., read a paper entitled "*Notes on the Pictou Coal Fields,*" which was accompanied by a chart of the district. *(See Transactions.)*

DONATIONS TO THE INSTITUTE.

SEPT. 1, 1866, TO AUG. 31, 1867.

The Provincial Legislature,.....$200 00
Rev. J. Cramp, D. D., President of Acadia College..... 2 00

LIBRARY.

IN EXCHANGE.

Boston.—Boston Society of Natural History Memoirs—Vol. I. Parts 1 and 2.
" " " " Proceedings. Vol. X., pp. 353–418. Vol. XI., pp. 1–208.

London.—Victoria Institute, Journal of Transactions; Vol. I, No. 1, Vol. I, No. 2, Vol. I, No. 3.

Montreal.—Canadian Naturalist, Feb. 1866—Dec. 1866.

New York.—Lyceum of Natural History—July, Aug., Sept., Oct., Nov., Dec., 1866.
American Journal of Mining—March 16, 30; April 13, 20, 27; May 4, 11, 25; June 1; Aug. 17, 24, 31; Sept. 7, 14.

Philadelphia.—Franklin Institute—Journal Sept., Oct., Nov., Dec., 1866. Jan., Feb., March, April, May, June, July, Aug., 1867.

Salem.—Essex Institute—Proceedings, April, May, June, July, Aug., Sept., 1867.

Toronto.—Canadian Journal, July, 1866.

PRESENTED.

Geological Survey of Canada—Atlas of Maps and Sections. Roy. 8vo., cloth, 1865. *The Canadian Government.*

On the Condition of the Deposition of Coal, &c., by Professor Dawson, F. A. S. *The Author.*

Abhandlungen herausgageben vom naturwissenschaftlichen vereine zu Bremen, 1866. *The Smithsonian Institute.*

Victoria Institute—Foundation list of Members. 4 copies

Geological Survey of Canada—Report of Progress, 1863–66.

LIST OF MEMBERS.

Date of Admission.		
1863.	June 24.	Almon, Hon. M. B., Hollis Street, Halifax.
1865.	Dec. 7.	Anderson, Lieut. Arch., Royal Artillery, Artillery Park.
1864.	April 3.	Bell, Joseph, Granville Street, Halifax.
1863.	Jan. 8.	Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
1864.	Mar. 1.	Campbell, W., Hollis Street, Halifax.
1865.	Oct. 6.	Chambers, A. P., Argyle Street, Halifax.
1865.	Aug. 25.	Clifford, Lieut. Col., Royal Artillery, Artillery Park.
1863.	May 13.	Cramp, Rev'd. J. M., D.D., *President of Acadia College*, Wolfville.
1866.	May 4.	DeMill, James, M. A., *Professor of Modern Languages*, Dalhousie College, Halifax.
1863.	Oct. 26.	DeWolf, James R., M.D., Edin., L. R. C. S. E., Dartmouth.
1863.	Dec. 7.	Downs, Andrew, *Cor. Mem. Zool. Soc., London.* Walton Cottage, W. Halifax.
1863.	Feb. 2.	Duvar, J. Hunter, Bedford Row, Halifax.
1864.	Oct. 26.	Finnie, A. S., Bank of B. N. A., Hollis Street, Halifax.
1865.	Oct. 4.	Fleming, Sandford, C. E., *Chief Engineer of Railways*, Halifax.
1866.	Feb. 1.	Forman, James, Thornfield, Halifax.
1863.	Jan. 24.	Fraser, R. G., Spring Garden Road, Halifax.
1863.	Jan. 5.	Gilpin, J. Bernard, M. D., M. R. C. S., Barrington Street, Halifax, VICE-PRESIDENT.
1863.	June 15.	Gilpin, Rev. Canon, D. D., Spring Garden Road, Halifax.
1863.	Feb. 2.	Gossip, William, Granville Street, Halifax, SECRETARY.
1863.	Jan. 26.	Haliburton, R. G., F. S.A., Halifax.
1863.	Oct. 26.	Hamilton, P. S., Granville Street, Halifax.
1863.	Jan. 26.	Hardy, Lieut. Col., Royal Artillery, Artillery Park, VICE-PRESIDENT.
1863.	June 27.	Hill, P. Carteret, D. C. L., Morris Street, Halifax.
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1867.	April 1.	Jennings, Edward, M. D., Halifax.
1863.	Jan. 5.	Jones, J. Matthew, F. L. S., Ashbourne, near Halifax, PRESIDENT.
1866.	Feb. 1.	Kelly, John, *Deputy Commissioner of Mines*, Province Building, Halifax.
1864.	Oct. 12.	King, Capt. J. R., Royal Artillery, Artillery Park.
1867.	Jan. 7.	Knight, Thos. F., *Receiver General's Office*, Province Building, Halifax.
1864.	Mar. 7.	Lawson, George, Ph. D., L.L.D., *Professor of Chemistry and Mineralogy*, Dalhousie College, Halifax.
1867.	Feb. 4.	L'Estrange, Capt. C., Royal Artillery, Artillery Park.
1865.	Nov. 9.	Lordly, E. J., George Street, Halifax.
1863.	Jan. 8.	Lyttleton, Capt. W., Hollis Street, Halifax, TREASURER.
1866.	Feb. 3.	Morrow, James B., Brunswick Street, Halifax.
1865.	Nov. 17.	Nash, J. D., Dresden Row, Halifax.

1865. Aug. 29. NOVA SCOTIA, The Right Rev. Hibbert Binney, D.D., Lord Bishop of
1867. April 1. O'Brien, W. D., *Manager of Street Railways*, Halifax.
1867. Mar. 1. Outram, Joseph, junr., Bedford Row, Halifax.
1863. Jan. 5. Poole, Henry, Glace Bay Mines, Cape Breton.
1866. July 28. Reeks, Henry, Manor Hall, Thruxton, Hampshire, England.
1866. Jan. 8. Rutherford, John, *Chief Inspector of Mines*, Province Building, Halifax.
1864. Mar. 7. Silver, W. C., Hollis Street, Halifax.
1865. Jan. 9. Sinclair, Lieut. Col. R. B., A.G.M., Dartmouth.
1865. April 20. Smithers, George, Granville Street, Halifax.
1867. April 1. Telfer, Lieut., *4th Regt.*, Wellington Barracks, Halifax.
1867. Aug. 16. Tobin, Stephen, South Street, Halifax.
1866. Feb. 1. Townsend, W. T., Argyle Street, Halifax.
1864. Dec. 5. Webber, Lieut. H. H., Royal Artillery, Artillery Park.
1864. June 1. Whytal, John, North West Arm, near Halifax.
1863. April 15. Willis, J. R., *Cor. Mem. Bost. Nat Hist. Soc., et Liverp. Micros. Soc.*
1866. Mar. 18. Young, Hon. William, *Chief Justice of Nova Scotia*, South Street, Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 26. Ambrose, Rev. John, M.A., the Rectory, St. Margaret's Bay.
1866. Dec. 3. Honeyman, Rev. D., F.G.S., Antigonishe.
1864. July 1. Marett, Elias, St. John's, Newfoundland.
1865. Dec. 28. Morton, Rev. John, Bridgewater.

CORRESPONDING MEMBERS.

1866. Sept. 29. Chevallier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1866. Feb. 5. Hurdis, J. L., Lower Chamberlayne Place, Southampton, England.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

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

No. III.

(*Read, November* 1866.)

In the two former papers I had the honour to read on the mammalia of this Province, I enumerated and described the several families of bats and shrews,—the two very marked representatives of the cat family—our lynxes; and the wolf and fox, with their varieties, representing the dog family. With the exception of the southern family of bats, feebly represented, we found our shrews, our lynxes, and our foxes, numerous and vigorous, beautiful in colour and strong to resist our Arctic winters.

The paper this evening will be upon the representatives of the weasel family in our Province, a true boreal fauna, and numerous, beautiful and vigorous. We find them contained in two genera and seven species. Formerly the genus Mustela contained the whole. But whilst all have common habits, long vermicular bodies, and lustrous fur, two species have thirty-eight teeth, four more than the rest, have bushy tails, and longer fur, attain to a larger size, and are arboreal in habits. Whilst the others have thirty-four teeth, slender tails, shorter fur, and attain a less size.

Mustela,—*or Tree-Martins.*

Mustela Pennanti,—*Fisher.*
Mustela Americana,—*Martin.*

PUTORIUS,—*Weasels.*

PUTORIUS VISON, } *Mink.*
PUTORIUS NIGRESCENS, } *Little Mink.*
PUTORIUS CICOGNANII, }
PUTORIUS RICHARDSONII, } *Ermine Weasels.*
PUTORIUS NOVEBORACENSIS, }

MUSTELA.

MUSTELA PENNANTI.—(*Erxleben*) *Fisher.*

Of two skins examined by me at Halifax, 1863, the following is the description :—They were both in the finest condition of winter pelage. End of nose black, face brown, but grizzled with short white hair, ears with short rim of cream coloured hair. General colour of back, shoulders, flanks, light brown, with an indistinct brindling of black about the neck, which runs into a dorsal line and ends at tip of tail. These black shining dorsal hairs are longer than the brown ones, and terminate in a beautiful pencil of hair at the point of the tail. Colour beneath very much lighter than above,—a broad medial line, and all the legs black, toes well covered, nails conspicuous and white, a large white spot in one, a few white hairs in the other on the lower belly and vent.

These skins presented the unusual appearance of an animal very much darker below than above, and were terminated by a bushy, well pointed and handsome tail. Length of the larger skin 48 inches, length of tail 17 inches. A mounted specimen belonging to the late Joseph Robinson, Esq., Halifax, measured from tip of nose to tip of tail 42½ inches, and tail 19 inches; the head and forehead rounded, nose sharp, ear round and close, with a light border, legs robust and well furred, claws white, the thighs muscular, and with the tail covered by much longer hairs than the upper portions of the body. I have examined many hundred skins but never have seen the animal alive.

This, the largest weasel in the world, requires a thick cover for its protection. It lives continually in trees, where it pursues its prey, sometimes squirrels; at other times it is seen hunting the martin. It feeds upon small birds and their eggs. Descending to the ground it hunts mice and weasels, surprises the ruffed grouse or alpine hare, and will not disdain frogs or dead fish cast upon the lake shores. It is accused of stealing the hunter's bait; and it is the only animal that attacks with impunity and devours the porcupine. Writers say it throws it over and bites it upon the belly. Mr. Andrew Downs informs me, that in skinning them, he often finds porcupine quills in their stomachs. Though timid and always evading pursuit, when brought to bay it fights desperately, and is a match for several dogs. That very accurate observer, Hearne, says they are

easily tamed, and show marks of great affection; whilst Audubon says of those kept by him, they were surly and morose, feeding greedily and skulking away in their cages. It brings forth three or four young at a birth, for which it constructs a nest in the hollow of a tree. Never very plenty, they are rapidly becoming extinct in our Province; from a hundred and fifty to two hundred are the very utmost now taken yearly; these chiefly come from the high wild region of the Cobequid hills in Cumberland. Dr. Richardson gives to this weasel the specific name of "*Canadensis*," quoting Schreber, whilst Dr. Baird (Smithsonian Institute) gives "*Pennanti*," from Erxleben, Schreber, dating 1778, Erxleben, 1777, and the doubt is further increased by Schrebers's great work having been many years in publishing—the title page being published previously to much of the text. One is pleased that the doubt is thrown in favour of the great Welch naturalist, whose name is thus justly retained for this large and magnificent arboreal weasel.

MUSTELA AMERICANA.—(*Turton,*) *American Martin.*

Of seven hunters' skins obtained from Mr. Thomas, fur merchant, Halifax, the following is a description:—No. 1 and 2 are dark mahogany brown, almost black, from the nose to the tail, the brown showing a little more on the sides, the tails are black at the root, a brown ring about the middle, then black at the tip. The faces of both are black, the ears dusky inside and out, but with a conspicuous white rim of very fine hair; beneath, the chins of each are blackish brown, a broad orange spot mixed in with black hairs, upon the throat, runs down between the fore legs; all the legs brownish black, and the belly and flanks, similar to, but rather brighter than back. The hair is coarse and shining, and very long at tip of tail.

No. 3 may be classed with No 1 and 2, but with less black on the back, but face pale greyish, orange spot on throat, much less vivid.

No. 4, 5, 6, 7. The same as regards size of ears, tail and legs, but the black on the back has faded into a dusky streak, the faces light ash with a brown wash, and a rich orange wash pervading the whole skin. The orange spot beneath the throat, very bright, almost fulvous, and running into the belly and lower side of the tail.

In another, the tail was bright brownish yellow, with black tip.

Thus we find two dark brown with dark faces, and five with more or less grey faces. The tail, legs, and rim of ears, coinciding in all. The orange throat accompanying the pale faces. I have never seen the animal in life, but from a mounted specimen belonging to Mr. C. Kaizer, Halifax, we have a high rounded back, triangular head, and very robust and well-covered limbs and tail. Entire length to tip of tail 24⅜ ins. length of tail 8 inches.

When we begin to study this species, we soon find a very great variety in colour, not only between summer and winter specimens, but between winter skins themselves, that are all in the highest condition. Whilst they all coincide in what may be called typical marks, such as colour of legs, tail, and especially ears, all of which have a very pale but conspicuous rim or border, they vary much in colour of face, some having black, others faces so pale as to be nearly white, and the pale faces have a lighter brown colour, and the orange throat much more vivid. These marks are important, as they point to a very intimate connection, if not identity, with the true Russian sable, which has a pale face. Till within a few years, it has been confounded with the pine martin of Europe, (*M. Martes.*) DeKay, Audubon, and even Sir John Richardson, describe it as such. Turton is the first, in his edition of Linnæus, to show its specific differences, and to give it the specific *Americanus.* Subsequently Dr. Brant, a Russian naturalist, in a monograph of the genus *Mustela*, calls it *Americanus*, shews its specific differences, but considers it identical in its white faced variety, with *M. Zabellina*, the Russian sable. In figure this animal resembles its congener, the fisher, though smaller—it has the same round ear, with a light border, round head, nose not so pointed, an arched back, and comparatively long and very muscular thighs and legs. The figure is set off by a handsome bushy tail, and glittering eyes. In its habits it is a true tree weasel, keeping in the densest pine forests, its food is small birds and their eggs, the smaller mammals, shrews, and wood-mice, squirrels and hares. It also preys upon frogs, lizards, and beetles, takes bait from the hunter's trap, and according to some writers, feeds also upon berries. It shows great cunning and boldness in defending itself, or attacking its prey, and has been seen winding a hare with tail erect, and nose to ground, like a small hound. It never approaches the open, but keeps to the thick pine cover, where it makes its nest within a hollow tree, beneath a rock, or even in an underground cave. It has six or eight at a litter. About one thousand skins from Nova Scotia are annually exported. Those from Newfoundland and Labrador

are much finer, darker in colour, and more lustrous in pelage than our own. They have pale faces.

We come now to the *Putorii* or true weasels. These, as before stated, have thirty-four teeth, have longer bodies, shorter legs and fur, thinner tails, and never take to trees. They are represented with us by two species of mink, and three species of ermine weasels.

PUTORIUS.

PUTORIUS VISON,—(*Richardson,*) *Mink.*

PUTORIUS NIGRESCENS,—(*Audubon,*) *Little Black Mink.*

Following Audubon and Baird, I have made two species of mink, founded rather in a very marked difference in size, than in any thing else, as they both coincide in general and typical marks and habits. I have never had a specimen in the flesh to examine, but the following description of skins taken from the Halifax market, will show their relative size :—

The largest mink skins measure from the tip of the fore-finger (the arm being extended) to the ear of a man ; the smaller to the bend of the arm. The hunters readily allow two kinds.

The largest measured was total length to tip of tail 32½ inches, tail 9½ inches ; the smallest measured 23 inches total, tail 6½ inches. These skins may be somewhat stretched, the tails contracted. The colour varies from nearly fawn to brown, brownish black, black, and finally, when in the highest condition of winter pelage, to an indescribable shining bluish black, with a glorious lustre. The lower parts are lighter than the back. The tip of chin is often white, the throat and between the fore-legs always white, with frequently a white line down the belly. I have seen two or three specimens with white tips to the tail, the smaller species is usually the darker. The feet are half webbed, very large, and have the soles naked. The head is round and truncated, the eyes very near the nose, ear round and short, back high, and hairy tail. The hair much finer and shorter than the martins.

These two species are common in the Province, and by no means decrease in numbers. Unlike the martins, their habits are familiar, and they approach out-houses and farm-yards, where they make great havoc among the poultry. They are good swimmers, and have been seen diving after trout. Their food is birds and their eggs, mice or shrews ; but he is preeminently the fisherman of his family, and frequents the rocky brooks and the sea side. Along the borders of the forest lake, his tracks, and the pile of clam shells attest his industry. Many an unlucky

frog is picked off in his hurried journeys from lake to lake, by this bright eyed fisherman.

This fur once valueless has steadily increased in price, till last winter not seldom five dollars was paid for a single skin. Our Indians trap but very little now. The idle boys about the villages take many. The farmer indignant at his slaughtered fowl yard, adds a few more skins. In every land and every village, there is a social gypsey who loves sport and hates work; who fishes, and fowls, and traps, eats his own trout, or poached salmon or moose meat, taken out of season, and exchanges his little pile of fur for tea and tobacco at the country store. Many come from this source. Thus a gathering pile collects and dangles at the country store. The owner packs and sends them to the Halifax market, where of late years it has become the habit for the fur dealers to tender in writing for them. About six thousand are annually exported from Nova Scotia proper.

PUTORIUS CICOGNANII, (*Bonaparte,*) *Small Brown Weasel.*

Under this head I put the common weasel or ermine weasel of the Province. From my notes its size and colour will be studied.

Wm. Dargie, at Annapolis Royal, gave me 10th Nov. 1860, a weasel, total length to end of tail, 11 5-10 inch, length of tail 4 9-10 inch. It was in summer pelage, with short fur —in colour it was brown, with upper lip, cheeks, inside of legs, side of belly two-thirds to back, front of hind legs and belly beneath white, genitals white, the pœnis with a bone, a deep sulphur, stain along the belly.

25 Nov., 1860, Mr. Melville, Hammond's Plains, near Halifax, gave me one, total length to end of tail 11 1-10 inch, length of tail 3 6-10 inch, this was in full winter pelage—fur thick, ears nearly hidden, feet well furred and colour white, with black tip to the tail, a pale sulphur tinge on flanks and belly. Thus I had two specimens within 10 days, one winter, one summer pelage.

28 Jan., 1861, Sgt. Kavanagh, Desertion Post, St. Margaret's Bay, gave me the smallest specimen I have seen—total length to end of tail, 10 1-2 inches, length of tail 3 1-10 inch. It was in winter pelage

21 Feb., 1861, he sent me the largest specimen I have seen, from the same out post—total length to tip of tail 14 4-10 inches, total length of tail 4 8-10 inches. It was in full winter pelage—fur very thick, and limbs very robust. Both white with a yellow tinge on flanks, tip of tail black.

Thus it appears that the ordinary weasel of the Province may be referred to *P. Cicognanii*, (Bonaparte,) *P. Fusca*, (Audubon, DeKay.) That he attains a larger size here than the southern species, but preserves the relative proportion of tail

always. The largest tail obtained, 4 8-10 inch, being less than P. Richardsonii, and the shortest obtained, 3 1-10 too long for P. Pusillus. This species so abounds, that perhaps in 1000 skins, 20 or 30 might be referred to Richardsonii, and I have only obtained one skin that I could refer to "*Noveboracensis*," whilst I have never obtained, though so common in New England, a single specimen of *Pusillus*, or common weasel. The almost insular position of the Province may account for this very limited range of species. My remarks refer to this species alone, as the others are so very rare that I have only got their skins. He is very numerous, though unseen, and is in some degree a nocturnal hunter—he clears the trap not only of bait, but also of the hare or grouse that lies entrapped. The forest or the sterile hills are his usual home, yet he often comes into the open, and frequents stone walls or the cellars of out-houses. Sitting motionless for a while in the forest, the hunter not unfrequently perceives the rustle of a leaf, and then a pair of glittering eyes peering out from it, and presently the daring little robber advancing and boldly tugging at his boot. At certain seasons, numbers congregate by the side of brooks, and will boldly attack intruders upon them. This happened to a gentleman at Aylesford, Nova Scotia, where he came upon a party at a brook side, which there crossed the post road. Their attitude was so hostile, that he was feign to retreat. It is recorded that a man was only rescued from death in Scotland, from an attack of this kind. It is all but impossible for a single man to long resist simultaneous attacks in front and back, leg, and arm, and throat, from a number of these bold sharp-teethed and nimble little creatures. It is interesting to record that the American species retain the habit of their European congeners. Mr. Melville, of Hammond's Plains, informed me that a weasel became gradually familiarized about his house, at first about the farm-yard, then picking up bits of meat thrown to it, and at last it made its nest beneath the porch, lining it with the fur of wood mice. It retained these quarters for two or three years, bringing up several litters, which it allowed him to observe, and finally was drowned in a harness cask. His

children lamented this wild pet, whose annual changes from white to brown and from brown to white they had so often seen. Of this change, which, according to Audubon, takes place suddenly (in large patches during one night,) and is completed in twenty days, I have had no opportunities of observing; I have had white specimens as early as middle of November, and perfect brown ones as early as April. Perhaps both these dates are early for the great body of them to change. Personally I have noticed in this little animal a bold and courageous figure, glittering eyes set low in a very triangular head, and glancing every where, a bounding gait when pursued, but when hunting quick mincing steps, and head carried high on an arched neck, turning from side to side incessantly. An arched back, and tail well-up, complete the figure of as high spirited, bold little fellow as haunts the forest.

PUTORIUS RICHARDSONII (*Bonaparte*).

In examining many hunters' skins I found several in winter and summer pelage whose tails were about five inches in length; the summer specimens all retained the white upper lip, which by some naturalists has been made a typical mark. Dr. Baird referred these skins to this species. They are very rare in the Province.

PUTORIUS NOVEBORACENSIS (*DeKay.*)

Mr. James Thomas, Halifax, gave me a skin obtained at Antigonish, Nova Scotia, which I refer to this species. It was in winter pelage—white, but with a brown patch on the forehead, and a light brown indistinct dorsal line, the belly and tail had a bright sulphur mark through the white, the latter tipped with black. Total length to tip of tail 21 inches, length of tail 7 2-10 inches, length of black tip 1 6-8 inch.

Our Province thus is represented almost solely by *P. Cicognanii*, which appears to have spread itself thoroughly in its limits.

The entire absence of *Pusillus* so common in New England, and the very great scarcity of *Richardsonii* and *Noveboracensis* may appear singular to those unacquainted with the very limited range many species have, and the small fauna, islands, and extremities of continents have, compared with central countries. The raccoon has but lately appeared amongst us, and in the Annapolis Valley has yet only penetrated the north mountain—being unknown on the south side of the valley. Our list of

reptilia is scarcely half that of New England, and batrachians are unknown at Newfoundland. It remains to make a few remarks on the adaptation of this beautiful boreal family to the country in which it lives—on the harmony of its strong life, fed on flesh, and wrapt in fur, with the stern winter in which it rejoices. Our hills glaciated to their summits by ancient ice, and our valleys cut out by the same invisible forces, have long since risen from their submergence, and been clothed by dense evergreen forests, our dark pines and firs. A winter, the counterpart of Norway, covers the whole in its mantle of snow. The bear and the marmot, each in his fat sleep, have left the scene; the mice have disappeared to their winter hoards; the ground squirrel is asleep, and the red squirrel is lying by in his nest for days. Beaver and muskrat are fast in their rushy mounds. Yet now this boreal group come forth, the colder the clime the more lustrous their fur, the more vigorous their movements. The great tree martins, with soft muffled silent tread, and furred foot, are hunting the feather-legged grouse, in common with the snow owl, the winter falcon, and the lynx, all feathered or furred to their toes. The mink is pursuing his prey along the half frozen water-courses; whilst on the snow clad hills, with breast as snowy, the fur-footed ermine is steadily winding the varying hare, whose foot is equally furred, coat as white and thick, but whose feeble heart will soon surrender to his cruel pursuer. Everywhere, the slant wintry sun throws his scant rays athwart dark pine and glistening snow. Everywhere, through the short silent wintry day, the furred and noiseless pursuer tracks the furred and noiseless pursued.

Art. II. On the Beaver in Nova Scotia. By Captain Hardy.

(Read December 3, 1866.)

The Beavers, both of Europe and America, have been so often and so accurately described scientifically by modern naturalists, that a recapitulation of their characteristics would be a useless insertion in the proceedings of this Society. With regard to the *Castor Canadensis*, the only and widely distributed species of the American continent, the remarks of Professor Baird of the Smithsonian Institute, in his report of the mammals of the Pacific railroad routes, summing up the evidence of naturalists on the comparative anatomy of the *Castors* of the old and new worlds, appear worthy of note as establishing a satisfactory distinction. The question has been elaborately discussed, and the results of many comparisons shew considerable difference of arrangement of bones of the skull, a slight difference as regards size and colour, and an important one as regards both the form of the castoreum glands, and the composition of the castoreum itself; Professor Owen, Bach, and others, agreeing on a separation of species. Hence, instead of being termed *Castor Fiber* (*Var. Americanus*,) the American Beaver now, (and but recently,) is designated as *Castor Canadensis*, so termed rather than *C. Americanus*, from the prior nomenclature of Kuhl.

From its former wide distribution in America, co-extensive with the whole northern continent, it may be readily inferred that a country like Nova Scotia, abounding in all the conditions necessary to its existence—rivers, brooks, and swampy lakes—should have been thickly populated by this interesting animal—a fact borne out by the prevalence of such names as Beaver-bank, Beaver-harbour, and the numerous Beaver-lakes and Beaver-rivers scattered round the Province; but so persecuted was it a short time since, for its fur for the hat-making trade—the market so near, and its haunts so accessible and so easy of observation, that it is strange to find the beaver still living in Nova Scotia, and, since the change of fashion from the use of its fur, to that of silk in hat-making, rapidly multiplying.

Its eastern limitation in this Province, is the Port Medway river, on which, and its tributary brooks, it is found sparsely. On the Liverpool river, six miles further to the westward, and throughout its parent lakes and waters, from Milton to within a few miles south of Annapolis, it occurs more abundantly, and is very numerous on the upper waters of the Sable river, the Jordan, the Roseway, and the Clyde, in Shelburne county. It is no doubt owing to the breadth of the Province here, at its western extremity, and the great extent of wild country left uninterrupted, with innumerable chains of lakes and brooks, that the beaver has been preserved, for it may be safely asserted that to the eastward of Port Medway, not one exists to the furthest cape of Cape Breton.*

The following observations on the Beaver are from notes taken during a recent canoe excursion on Lake Rossignol and its tributary waters, which discharge into the Liverpool river in Queen's county.

Our canoes were placed on a chain of small lakes and connecting runs, called the Sixteen Mile Brook, which, easily reached by a short portage from the post road between Annapolis and Liverpool, communicates with the great lakes; and here I first saw the works of beaver. Passing through a picturesque brook between two of the lakes, completely shaded over by maples, and its banks covered with rank masses of king-fern, and the twining tendrils of the Indian potatoe, (*Apios tuberosa*,) now in flower, we came on a large dome of sticks rising from the water's edge, the Indians at the same time exclaiming "there beaver house." It was apparently (for we could not stop to examine it from the swiftness of the current) about four feet high, and about nine or ten in diameter at the base, evidently partly built in the water and partly on shore. So rough looking and loosely constructed did it appear, that I could not repress a feeling of disappointment from all that I had heard of the marvellous construction of a beaver house.

*They were formerly numerous throughout the Province. Sir C. Lyle mentions Beaver cuttings dug up in a peat bog, near the Shubenacadie, which the workmen had supposed to have owed their origin to Indian tools. A few years since the remains of a beaver dam were discovered in the brook running into the North West Arm, by the road to the Dutch village

Shortly afterwards we passed a slight obstruction in the stream, formed of a quantity of poles and brush-wood, which proved to be an old beaver-dam, partially carried away. Two days afterwards, on the Tobiaduc river, which we ascended after crossing lake Rossignol, we had a better opportunity of examining a dam, as we camped in its neighbourhood for two nights. We had arrived nearly at the head waters of the stream, and were paddling up the narrow channel, enjoying the exquisite scenery presented as we turned the frequent bends, when our progress was suddenly opposed by what appeared an artificially constructed waterfall, about three feet in height. It was a perfect beaver-dam, over which the water poured in an even sheet. The clumps of king-fern on either side were much beaten down by the paths of the animals, whose recent works were fully attested by some fresh bushes with the leaves quite bright, which had been thrown on the top of the dam. The water above, as far as we could see, was still, with a strip of wild meadow grass on either side. Their houses, as the Indians said, were at some distance above. The difficulty experienced in removing a portion of the dam, to allow of the canoes being dragged over, gave evidence to the solidity of its construction, which appeared to be as follows:—poles of poplar, willow, and alder, 8 to 15 feet in length, laid and woven together across the stream, formed the frame, which was stuffed and plastered, especially on the side supporting the water, with mud, grass tufts, stones and leaves. The breadth at the top was three feet, and appeared to increase considerably towards the bottom. The front of the dam was supported by stakes and bushes leaning against it, their ends planted in the bottom of the stream. The whole structure was a model of solidity and strength, capable of supporting as many men as could stand together on the top, and adapted to resist the heaviest freshet. It was apparently kept in constant repair; piles of old decayed poles lay on the bank, which had evidently been removed and replaced; the fresh bushes laid on the top had been cut but a few days. This dam, and one or two others which I had an opportunity of observing, was built straight across the stream; but it is a well-authenticated fact

that in larger works, where the channel is broader, and liable to heavy water, the dam is made convex to the current.

As the beaver residing on the lakes does not build a dam in the vicinity of his dwelling, the reason of the strong instinct implanted in this animal to produce these marvellous constructions under other circumstances becomes apparent. Whenever from the situation or nature of the water, there is a probability of the supply becoming shortened by drought, and to ensure sufficient water to enter his dwelling from beneath the ice in winter, the beaver constructs a dam below to maintain the supply of water necessary to meet either of these contingencies. In former years, when beaver abounded in all parts of the Province, it is evident from the numerous beaver meadows now left dry, that they took advantage not only of valleys traversed by small brooks, but even of swampy lands occasionally inundated by heavy rains.*

Thus doubtless were formed those numerous savannahs, termed wild meadow lands by the settlers, which abound in the interior. A young pair of beavers, driven from some colony to seek a fresh home through scarcity of food, chose some virgin brook, and built their dam. Large spaces in the woods thus became inundated, and heavy rains and freshets continually brought accessions of fine soil from the surrounding hills. At length the beaver was exterminated, and though all traces of his home and defences disappeared, an enduring monument of his industry still survives him, and is eagerly sought by his thankless destroyers, for the rich waving field of wild grass which grows on the site of his former aquatic territory.

With respect to the houses—we had opportunities during the excursion alluded to, to examine several, and in every variety of situation—by the lake shore, on the edge of swampy meadows fringing sluggish waters, far back up some small forest brook, or when built on the brink of a rapid river. They all presented a similar appearance, all equally rough on the exterior

*Crossing a small grassy meadow in a valley in the woods near Liverpool River during the past fall (1866), we found the water standing nearly as high as the knee, and as the depth was not to be accounted for by the recent rains, we passed round to the foot, where a newly constructed beaver dam still unfinished explained the occurrence.

as the first one alluded to, as seen on the sixteen mile brook, and all similarly constructed in the interior; wherefore the following description of one which we unroofed, will suffice to show the general construction of the edifice of the beaver in Nova Scotia.

It is a large and rather rudely constructed pile of sticks, mud, stones, and grass tufts, containing a chamber, and sloping passage or passages leading into the latter from below the surface of the water. The house has a very large diameter at the base in comparison with its height, and instead of the regular conical dome, smoothly plastered over with mud, which we see so frequently drawn in works of natural history as representing beaver houses, it presents the appearance of a great pile of barked sticks, the shape of the mass far nearer resembling an inverted saucer than a cup. The sticks, some of which are of great length, are, on the top and exterior, thrown on rather loosely. As you unpile them, however, and examine further into the building, the work will be found better, and the sticks laid horizontally, firmly bound in with mud-plaster, stones and grass being interwoven throughout. The bed on which they lie is at the back of the chamber, raised above the level of the hall, as it may be termed. The sticks projecting towards the interior are smoothly gnawed off, particularly round the bed, the bottom of which is covered with dry grass, or, where this cannot be procured, with fibres of wood split with their teeth into fine shreds. The chamber, and passage leading into it, have a gentle slope upwards; the bed is never under water though the hall may be flooded. The dimensions of the houses we observed were varied. A diameter of seventeen feet at the base would entail a height of the dome above the water line of four feet six inches, an interior diameter of about nine feet for the chamber, the height of which was about three feet. In all the houses there was but one chamber, though this was connected with the water in some instances by several tunnels and at different levels, evidently intended to suit the level of the water at different seasons, the lowest probably to be used when the thickness of ice should debar entrance to the others. At

the time of year when we inspected these works, the beaver were beginning to repair damages both to houses and dams. The house is approached from the water by long trenches, hollowed out to a considerable depth in the bottom of the lake or brook. In these are piled their winter stock of food, short lengths of willow and poplar, which if left sticking in the mud at the ordinary level of the bottom below the surface, would become impacted in the ice. The beaver travels a long distance from his house in search of materials, both for building and food. I saw the stumps of small trees, which had been felled at least three-quarters of a mile from the house. Their towing power in the waters, and that of dragging on dry land is astonishing. The following is rather a good story of their coolness and enterprise told me by a friend, who was a witness to the fact. It occurred at a little lake near the head waters of Roseway river. Having constructed a raft for the purpose of poling round the edge of the lake, to get at the houses of the beaver, which were built in a swampy savannah otherwise inaccessible, it had been left in the evening moored at the edge of the lake nearest the camps, and about a quarter of a mile from the nearest beaver house, the poles lying on it. Next morning, on going down to the raft the poles were missing, so, cutting fresh ones, he started with the Indians towards the houses. There to his astonishment was one of the poles, coolly deposited on the top of a house.*

The work of building or repairing houses and dams is invariably carried on during the night. The following is the *modus operandi:*—Repairing to the thickets and groves skirting the lake, the beaver, squatting on his hams, rapidly gnaws through the stems of trees of six or even twelve inches diameter, with its powerful incisors. These are again divided, and dragged away to the house or dam. The beaver now

*The food of the beaver consists of the bark of several varieties of willow, of poplar, and birch; they also feed constantly during summer on the roots and tendrils of the yellow pond lily, *nuphar luteum*. They feed in the evening and throughout the night. For winter supplies the saplings of the above mentioned trees are cut into lengths two and three feet, and planted in the mud outside the house. Lengths are brought in and the bark devoured in the hall, never on the couch, and when peeled, the sticks are towed outside and used in the spring to repair the house.

plunges into the water, and brings up the mud and small stones from the bottom to the work in progress, carrying them closely under the chin in its fore-paws. The vulgar opinion that the broad tail was used to plaster down the mud in its work, has long since been pronounced as erroneous. Its real use is evidently to counterpoise, by an action against the water in an upward direction, the tendency to sink head foremost (which the animal would otherwise have) when propelling itself by its powerful webbed hind feet, at the same time supporting the load of mud or stones in its fore-paws under the chin.

We had but two opportunities of seeing these animals at Lake Rossignol; once, when passing a steep bank covered with rank ferns and foliage, a rush through the bushes and a splash proclaimed that we had suddenly disturbed beaver—a rare thing during the day-time. The Indians traced his wake to another position on the opposite bank, where we perceived an old house, whence we again heard him plunge into the water as we approached in the canoes.

Another and more interesting sight was afforded us one calm summer evening, on silently paddling up a picturesque cove filled with lilies, at the head of which was a beaver house built at the foot of a large maple. Ensconcing the canoes in the tall ferns which overhung the water, we remained motionless for some time, during which the twilight so deepened that I began to despair of seeing the animals. Presently, however, the Indian's paddle was quietly pointed out on the lake, and following the direction we saw a beaver's head circling round amongst the lilies, and then the back rolling round like that of the porpoise, as he noiselessly dived to the bottom to feed on the lily roots. Then we started with strong though quiet sweeps towards the spot, and again resting motionless saw the animal re-appear and dive without having discovered us. Two or three times was this repeated, until within range, and I fired. "Too low," said the Indian, quickly, to our disappointment, and as it proved. The daylight was too far gone.

One of the principal causes which have nearly led to the extermination of the Beaver,* was the demand for the castoreum,

*The primary cause was doubtless the demand for the fur for hat-making by the Parisians.

and the discovery that it could be used as an unfailing bait for the animal itself. This substance is contained in two small sacs near the root of the tail, in which it is deposited, of an orange colour. Now seldom used in pharmacology for its medicinal properties, (stimulant and anti-spasmodic,) being superseded by more modern discoveries, it is still used in trapping the animal, as the most certain bait in existence. It is said to be likewise efficacious in trapping the wild cat, which is excessively fond of the odour. Mr. Thompson, a Canadian writer, thus speaks of it: "A few years ago the Indians of Canada and New Brunswick, on seeing the steel trap so successful in catching foxes and other animals, thought of applying it to the beaver, instead of the awkward wooden traps they made, which often failed; at first they were set in the landing paths of the beaver, with about four inches of water over them, and a piece of green aspen for a bait, that would allure the beaver to the trap. Various things and mixtures of ingredients were tried without success; but chance made some try if the male could not be caught by adding the castoreum, beat up with the green buds of the aspen. A piece of willow about eight inches in length, beat and bruised fine, was dipped in this mixture; it was placed at the water edge about a foot from the steel trap, so that the beaver should pass direct over it and be caught; this trap proved successful, but, to the surprise of the Indians, the females were caught as well as the males. The secret of this bait was soon spread—every Indian procured from the trader four to six steel traps; all labour was now at an end—the hunter moved about with pleasure, with his traps and infallible bait of castoreum. Of the infatuation of this animal for castoreum, I saw several instances. A trap was negligently fastened by its small chain to the stake, to prevent the beaver taking away the trap when caught; it slipped, and the beaver swam away with the trap, and it was looked upon as lost. Two nights after he was taken in a trap, with the other trap fast on his thigh. Another time a beaver passing over a trap to get the castoreum, had his hind leg broken; with his teeth he cut the broken leg off and went away. We concluded that he would not come again, but two nights afterwards he was

found fast in a trap, in every case tempted by the castoreum. The stick was always licked or sucked clean, and it seemed to act as a soporific, as they always remained more than a day without coming out of their houses."

Such being the ease with which this much persecuted animal was formerly taken, with a prodigious demand for its skin, it would seem a special interposition in its behalf, when a change of fashion in Paris suddenly substituted silk for beaver hats—"thereby," as a writer has said, "possibly altering the physical conditions of a continent." Though from its extreme shyness it retires fast from the neighbourhood of civilization, yet, persecution having in a great measure ceased, it will still exist in those remoter forest districts, which, from their nature, will probably never be cleared by the settler's axe. May they long remain in undisturbed possession of these their last strongholds, and reward the search of the friendly naturalist by the sight of those wonderful architectural labours and displays of foresight, for which the beaver is so justly celebrated.

Art. III. Remarks on the Minerals Prepared for the Paris Exhibition. By Prof. How, D. C. L., *University of King's College, Windsor.*

(*Read Jan.* 7, 1867.)

In making a few remarks on the minerals to be sent to the Paris Exhibition, I may say in the first place, that comparing the present collection with the specimens sent to the last two exhibitions, there is in some directions a decided improvement. This is particularly seen in those minerals which are commercially most important, viz., in gold, coal, and iron; but it is true also as regards some other minerals which may hereafter be found to admit of application; and there are interesting novelties, also, in those minerals which are solely of scientific interest.

The collections made on the present occasion will no doubt interest in a high degree men of science—men whose business is mining or metallurgy—really educated men, and the intelligent of those classes which have not had time or opportunity to make their acquaintance with these objects extensive.

The plan on which the mineral collections now to be sent, are arranged, is this :—

1st. There are shewn by different exhibitors, specimens of large size, illustrating the nature of economic minerals, such as coals, iron ore, manganese ore, paint and cement stones, building stones, and marbles.

2nd. There is exhibited by the Provincial Government, a collection of gold specimens.

3rd. There is a collection selected from the minerals of the late Dr. Webster, and arranged by myself.

4th. There is a collection arranged by myself, intended to shew generally the nature of the minerals found in Nova Scotia, and, therefore, to contain as far as practicable, an illustration of every class of minerals, and of their most striking varieties met with in the Province. This collection is to return to find a place in the Provincial Museum, for which a room of 70 ft. by 30, is set apart in the Provincial Building now in course of erection.

As it has been found necessary to send away some of the larger specimens of minerals, what is shewn at the local exhibition forms but a part of the whole collection. The specimens which have been forwarded under the head of class 40, "Mining and Metallurgy," are these :—

COALS.

1. A column of coal from Little Glace Bay, C. B., in the name of Edwd. P. Archbold, Esq. Dimensions when cut, 9 ft. 6 ins., by 2 ft. 10 ins.
2. A column of coal from Caledonia Mine, Little Glace Bay, in name of Henry Poole, Esq. Dimensions, 8 ft. thickness.
3. A column of coal from Gowrie Mines, C. B., in the name of Hon. T. D. Archibald. Dimensions, 5 ft. in thickness.
4. A column of coal from Cow Bay Mine, C. B., in the name of Robt. Belloni, Esq. Dimensions, probably 9 ft. in thickness.
5. A column of coal from Sydney Mines, Cape Breton, in the name of G. M. A., (R. H. Brown, Agent.) Dimensions, probably 5 ft. thickness.

6. A column of coal from Albion Mines, Pictou Co., in the name of G. M. A., (— Hudson, Agent.) Dimensions, 37ft. 10 inches in height.
7. Oil coal (and oil) from Albion Coal Fields, in the name of J. W. Jackson, Esq.

It is needless to say that a display of such massive samples of coal, which are accompanied in some cases by plans of workings and statements as to quality, must produce a very striking effect.

IRON ORES, OR PRODUCTS.

Ores, pig iron, bars, and cutlery, by the Acadia Charcoal Iron Co., Londonderry.

Brown hematite iron ore, from Brookfield, by W. Barnes, Esq.

Brown hematite and specular iron ore, by J. B. Oxley, Esq.

I am not acquainted with the last named iron ores, but the others are very similar in appearance and no doubt in quality. They are very pure and rich ores. The quality of the iron and steel afforded has been proved with the Acadia ores, and is well known to be of a very high order. The Brookfield ore I have analysed for the proprietors, and it gave—

Water,	11.36
Silica and gangue,	1.54
Phosphoric acid,	trace
Magnesia,	trace
Peroxide of iron and a very little alumina,	87.10
	100.00

results which show it to be a very pure and rich ore.

MANGANESE ORES.

Pyrolusite, from Teny Cape, by J. D. Nash & Co.

Pyrolusite, from East Mt. Onslow, by Robert Murray, Esq.

The Teny Cape manganese ores are now well known as among the richest and purest yet found in the world. The average per centage of manganese, in the best samples, will probably be at least 90 per cent. The Onslow ore looks very good, and will no doubt give a high per centage of manganese.

Like the Teny Cape ore, it is in clean samples, very free of iron.

PAINT STONE.

Umber forming rock, from East Mt. Onslow, by Robert Murray, Esq.

Paint and cement stone, from Chester Basin, by W. Sutherland, Esq.

These paint stones are very interesting rocks. The Chester stone I have found to consist of lime-stone, impregnated with carbonates of iron and manganese, which, by exposure to weather, becomes changed to hydrated oxides, and afford umbers of characteristic colours, which form admirable paints. The Onslow umber has no doubt a similar origin to that from Chester Basin. The Chester stone has been found to yield excellent cement. Specimens of this are to be seen at the local exhibition.

Large samples of red, white and variegated Plaster, from Antigonish Harbour.

In addition to these there has been sent

A collection of rocks, minerals, ores and fossils, with maps and sections illustrating the Geology of Nova Scotia, by Dr. Honeyman.

In this collection the minerals will be shown in their relation to the rocks in which they are found, so that their mode of occurrence will be illustrated, and a most interesting study will be afforded to geologists and mineralogists. In speaking now of the minerals which remain and will be on view here, I will preserve the order in which they will be seen by visitors. In the first place will be observed the "collection of gold nuggets, and auriferous quartz from the various gold fields of Nova Scotia, prepared by P. S. Hamilton, Esq., Chief Commissioner of Mines. It is accompanied by a gilt pyramid, representing the bulk of the gold extracted in N. S. from Jan'y. 1st, 1862, to Sept. 30th, 1866, as per official returns. The weight of this bulk of gold is 84,706 oz., 14 dwt., 10 grs.; value $1,632,315 $\frac{80}{100}$.

The specimens of quartz and gold are from eleven districts, viz:—Sherbrooke, Oldham, Tangier, the Ovens Lunenburg, Waverly, Renfrew, Uniacke, Lawrencetown, Montague, Wine Harbour, and Gay's River. Many of these are of exceeding richness, and the collection illustrates beautifully the mode in which gold occurs in the Province, and the characters of the metal found. The total value of the specimens is very roughly estimated at not less than $1500.

Leaving these glittering specimens, whose value is likely to meet with ready appreciation, we come to

Building Stones: Here we have three fine granites, and three freestones, furnished by H. Peters, Esq., and some freestones from Hants Co., by J. Wood, Jr., which do not bear so good a character as their neighbours. There is also a "firestone from Falmouth," which is much used in building fireplaces, and is said to stand very well, it has been approved of by judges in Halifax. A very interesting addition to these rocks is made by H. Webster, Esq., of Kentville, who furnishes an "ovenstone" from the red sandstone of Cornwallis, which is cut to any shape with the greatest ease with an axe, and answers an admirable purpose in making ovens. Side by side with this are remarkably fine specimens of barytes or heavy spar from Five Islands. Though not very bulky, the two probably weigh 200 lbs; they give the idea that the mineral is found in quantity, and they are pretty free from copper pyrites, which appears to be the only impurity present. I have little doubt these specimens will be much coveted for museums when they reach Paris. Close to these specimens are the

Marbles: Here we find a specimen of the white marble, from Five Islands, which unfortunately has turned out not so good as the sample exhibited in 1862; it is of course a surface specimen, and has no doubt been affected by frost. There are also two or three specimens of the very remarkable and beautiful wave-lined grey marble from New Glasgow: these would, I have little doubt, be made to go a great way in inlaid work in the hands of an old-country lapidary. I have no hesitation in saying that this is likely to attract considerable attention. There is also a beautiful green marble from Five Islands, and

some handsome white and red specimens from Cape Breton. Leaving these we pass to

THE WEBSTER COLLECTION: Here we have a truly attractive display of those minerals which are useful for study, and as illustrations of the manifold beauty with which our earth is adorned, but are not, with one or two exceptions, of economic value. These specimens have been selected from those collected by that zealous and indefatigable student of nature, the late Dr. Webster, of Kentville, and most generously placed at the service of the Province by his widow, on condition that they be kept distinct from other minerals, as the Webster collection in the Provincial Museum. It is not necessary for me to say more than that of a special class of minerals for which this Province is well-known in the best informed scientific circles, the collection forms a very good set of illustrations. Especially admired will be the group of amethysts,* which contrast so well with the neighbouring more brilliant and colourless apophyllite, which is here represented in the finest specimens I ever saw here. The singular and varied forms of stilbite will certainly attract the eye of the general observer, and charm the mineralogist. Fine specimens of needlestone, some in crystals so thin as to show why it receives this name, and some in thicker prisms forming natrolite, are side by side with very different looking chabazite of various tints. Here is also a very beautiful "slate," which is very easily cut with a knife, and exhibits a charming variety of patterns executed in lines of different colours: this might no doubt be placed among economic minerals, as it would form attractive surfaces not liable to be scratched. I am under the impression that there is abundance of the rock. The infusorial earth here shewn is valuable as a polishing material. Immediately beyond the Webster case is a group illustrating the gypsum of Hants Co. In these specimens we have shewn the leading varieties of those rocks which are employed for agricultural purposes, and for making plaster for walls and ceilings. Close to these we have a fine

*While speaking of amethysts, I may say, that there is a tradition that a Nova Scotia amethyst adorned the Royal Crown of Louis XIV, of France. If such a stone did find such a place, it may have been transferred to the Imperial Crown.

illustration of the oil coal from Pictou Co., which is known to yield a considerable amount of oil by distillation; the oil produced is also shewn in two specimens, distilled by the exhibitor, Mr. Jackson, one of which represents the crude oil, and the other the oil refined by a second distillation. We then come to the

General Collections of Minerals.—The first case we come to contains duplicate specimens of minerals of which finer specimens are in the other cases, along with some clays and a few other species. In the other three cases are specimens too numerous to describe in full: among them I may mention as specially interesting, minerals of the same name as some in the Webster collection, but exhibiting very interesting variations from the most common forms. Here are very fine specimens of analcime alone, and most exquisite groups of analcime and natrolite, fine examples of apophyllite, and the most beautiful specimen I ever saw of that form of chabazite which from being found only in Nova Scotia is called acadiolite. It is in rich red crystals nearly cubical in shape, the common form being white or nearly colourless. Here too are a few minerals which will be especially interesting to the mineralogist as being entirely new to him, from not being found out of Nova Scotia, or as being found in very few localities, namely, centrallasite, mordenite and faröelite. Among these minerals may be mentioned one which if found in quantity would have the additional interest of being very valuable in a commercial sense. I speak of a mineral I found several years ago, in the gypsum of Windsor, called natroboro calcite. It is known to occur only in a few other localities. It is rich in boracic acid, and on this account is very much valued in forming glazes on pottery, for which purpose it is exported from Peru, where alone so far it has been found in quantity. When I first described this mineral as met with here, the attention of an English pottery maker was drawn to it by some newspaper account of what I had found, and he wrote to me asking for some of it to try in glazing pottery. I sent a sample and in return received a piece of pottery glazed with the mineral I had forwarded used alone, accompanied by the statement that used in this way the Nova Scotia mineral formed an excellent glaze, while the custom was to use borates along with

other substances. The value of such mineral was stated as probably £20 stg. a ton, delivered in Liverpool. (Since this paper was read I have found this borate in plaster from two other places in Hants Co., which have also furnished me with an entirely new borate soon to be described.) Here may be seen also a specimen of the "pencil-stone" discovered by Dr. Honeyman, and of a pencil cut from it with a knife. This mineral is found over a considerable tract of country. The pencils from it are very soft, and much prized in Antigonish for writing on a slate. In the same case is a specimen of magnesia alum, which I described a few years ago as being found in Newport, where it occurs in a shale which appears to be constantly producing it by action of the weather. If there were a demand at a remunerative price, alum might be made from this rock. I found small quantities of nickel and cobalt, both valuable metals, in the alum; hence they may exist in the neighbourhood in useful amount.

In these cases are to be seen illustrations of all the ores of manganese found here—specimens of wad or earthy manganese, one of which contains cobalt, are shewn from two localities, this ore is used as a mineral paint; manganite, used for some purpose in the States, is also there; and the best ore, pyrolusite, is shewn in several varieties from Onslow, Teny Cape, Walton and other localities. Of iron ores there are a good many specimens,—magnetic iron from Annapolis and Cornwallis, and the hematite ores from Brookfield, Pictou and Londonderry, shew the richest kind of ores known to exist; to these may be added various samples of titaniferous ores. Of mineral paints which consist largely of hydrous oxide of iron, generally with more or less oxide manganese, there are several specimens of various colours. The umbers from the Chester and Onslow paint stones before spoken of, and the fine ochres from Folly River, and Antigonishe, and others, shew that of these most useful materials there is a considerable variety. As for quantity, it is known that there are large supplies to be drawn from. A few coals are exhibited here, not as rivals to the large specimens, but as rendering the collection a complete illustration of the kind of minerals found in the Province, and among them are

varieties quite interesting to the Mineralogist, some of which I owe to R. G. Haliburton, Esq.; allied to these is a very valuable addition to the class of combustible minerals discovered by W. Barnes, Esq., namely, mineral pitch or bitumen, which is shewn in most perfect globular masses and in other forms in crystallized calcite and limestone. There is a good deal of scientific interest attached to this specimen, which I propose describing fully hereafter;* in the mean time I may say that it may turn out to be closely allied to the famous albertite of New Brunswick. A few specimens of clays are shewn from which common bricks, firebricks and pottery are made in the Province.

Copper is shewn in the native state from three adjacent localities in the Bay of Fundy, and copper ores from several parts of the Province. The ore from Polson's lake, of which it is reported that the long sought vein has just been found, and the rich ore of Tatamagouche are among these; there is also the beautiful chrysocolla or green silicate of copper from Cheticamp, and grey copper from several localities: the curious cupriferous oxide of iron from Five islands is well represented. Attention may be drawn also to the magnetic iron pyrites which I have found to contain nickel, to the arsenical pyrites containing gold, and the ores of molybdenum, as interesting and possibly hereafter commercially valuable ores.

A pretty complete set of specimens shews the great variety of forms in which gypsum or plaster occurs; we have it red, pink, black, white, opaque, and clear as glass, and perfectly crystallized, in one specimen most curiously imbedded in a clear crystal of glauber salt; it is also shewn in the compact form adapted for carving, as shewn in the specimen neatly executed by C. Harding, Esq., of Windsor. The mass of selenite is very good and will probably be much admired. Close by these are a set of specimens shewing some of the varieties of hard plaster. Very fine cabinet specimens of barytes are shewn, and some very curious forms of calcite or calcspar, one of which in the nail-head form of crystals, which looks like heads of nails which seem to take their form from three blows with a hammer,

*Described in Phil. Mag., May, 1867.

is especially attractive, while the others are hardly less so from the beautiful contrast of the snow-white calcite with the black lustrous pyrolusite on which it lies. Near these are shewn several forms of limestone and allied minerals suitable for fluxes, lime-making, and the manufacture of cements.

I need hardly point out the cornelian—as the four specimens of this are sure to attract attention by their brilliant red colour and high polish; close to these is a fine group of amethysts, and near them several varieties of jasper of different colours, one of which is not unlike the jasper of Arthur's Seat, Edinburgh, and was found far away from its native place, which no doubt was the shore of the Bay of Fundy, in a field in Hants county, among other drift materials. Here too are curious crystals of smoky quartz, eaten away as it were by chlorite, and nearly black quartz from Blomidon, chalcedony also and cacholong. Among the lead ores is a specimen in fine crystals from the Joggins, and one rich in silver from Victoria County; a few specimens of gold quartz and sand are shewn for the sake of having the collection more complete, and finally I may mention a piece of plumbago or blacklead, not however of good quality.

Beyond the cases we have a group of specimens of hard plaster, four in number, which have already attracted a good deal of attention, and one has been much admired as a material which, if it will only maintainits present appearance, will be valuable for making mantle-pieces, jambs of fire places, and such internal decorations as are not subject to being scratched. One sample is in the form of a table top, one, the most admired, is in the form of a pedestal, and two others are dressed and polished in angular blocks. They differ from each other and represent only some of the forms under which the rock is found. We then find tolerably large pieces of magnetic iron ore from Cornwallis, of hard manganese from Cheverie, copper ore from Five Islands. Then we have a complete and instructive set of specimens showing the way in which the rich copper is found with coaly vegetable remains in sandstone at Tatamagouche. A very beautiful incrustation of the rich green carbonate of copper adds much to the appearance of some pieces. Very fine specimens of Londonderry iron ore follow, and next we have a

set of specimens illustrating the character of sands used for making of bricks, and for moulding in brass and iron: of one of these (Mr. Pellow's from Windsor) a cargo of 250 tons was lately shipped to Boston for brass tube casting. Then we have a set of specimens from Springville, East River, Pictou, showing the character of the rich specular and brown iron ores found there, the latter I found to contain nearly sixty per cent. metallic iron, and there is a specimen of the East River limestone from which lime is largely made and exported: very much esteemed in the neighbourhood of New Glasgow.

I am afraid my remarks are somewhat crude and imperfect, but I must plead want of time to produce any thing more complete, and I hope such as they are they will be of service in marking the most important features in a collection of minerals which I think will be found very useful in illustrating the mineralogy of the Province, and of great interest to all who have devoted any attention to the subject.

Art. IV. On the Tides of the Bay of Fundy. By P. S. Hamilton.

(Read Feb. 4, 1867.)

The general outlines of the Bay of Fundy are well known. Its width, by a direct line from Brier island, the most western point of Nova Scotia, skirting the south-western point of Grand Manan island, to the coast of Maine, a short distance west of Quoddy Head, may be called in round numbers, fifty statute miles. From its mouth, it extends in a course as nearly as possible, due north-east, with nearly straight shores but a gradually decreasing width, for about one hundred and ten miles, when its waters separate into two arms known as the Minas channel and Chiegnecto channel. A line drawn directly from the northern to the southern shore in the immediate vicinity of cape Chiegnecto, the point of bifurcation, will show its breadth to be there about thirty miles. Following the more northern or Chiegnecto channel a further distance of about thirty miles, we find its waters again nearly equally divided. One—Shepody bay—extends in a northerly direction into New Brunswick, and

at its head receives the waters of the Petitcodiac and Memramcook: the other continues the original north-east course, and eventually forms *Beau basin*, or Cumberland basin. The distance from the mouth of Chiegnecto channel to the head of Cumberland basin may be called in round numbers fifty miles. Returning to the southern or Minas channel, we find that its general course from the mouth is nearly due east, a distance of about eighty miles, to the head of navigation at Truro. A glance at the chart will show that the contrasts in the conformation and position of these two arms of the Bay are very great, and I shall presently shew that the character of their respective tides is materially affected by these differences.

The northern shore of the Bay is a rugged "iron-bound" one, composed of a hard metamorphic rock, from its mouth nearly up to Shepody bay. The margin of this northern shore is more indented, and the outline of the hills which compose it is more uneven, than on the south side of the Bay. Towards the west these hills are of moderate elevation, but as a rule, they increase in altitude as we proceed eastward, until in Shepody mountain, near the bay of the same name, they attain a height of 1050 feet. The south shore exhibits a wall-like ridge of trap rock, associated with new red sandstone, from three to five miles in width, and from four hundred to seven hundred feet in height, stretching from Brier island to Cape Blomidon, and broken only by the deep narrow gorges of Grand passage, Petite passage, and Digby gut. The lofty isolated, or semi-isolated masses of rock known as Cape d'Or, Spencer's island, Cape Sharp, Partridge island, the Two islands, Five islands, Gerrish mountain, and some others of less note on the north side of Minas channel, belong to the same formation. As these latter headlands are within the range of parallel of three submarine ledges running parallel with the present south shore, and at the respective distances of three, five, and nine miles therefrom, it is probable that all were once parts of the same trappean range. Cape Chiegnecto, the western termination of the metamorphic Cobequid hills, rises almost perpendicularly from the water for eight hundred and fifty feet; and a short distance back attains a height of nine hundred feet. The remaining shores of Cumberland basin

consist of broad expanses of marine alluvium and low cliffs of carboniferous sandstones and shales; those of Minas basin, of marine alluvium and low cliffs of new red sandstone.

The tides of the Bay of Fundy have attained an almost world wide celebrity. This is no matter for surprise, for some of the phenomena pertaining to them are of a very striking and impressive character, and yet no more striking than singular. Without pausing to discuss the theory of the tides generally, I will proceed at once to describe some of the more noteworthy of these phenomena.

The great volume of water which sets into the Bay with the flood, comes from the south. The tidal current on entering the mouth of the Bay, is much accelerated, owing to the gradual narrowing of the bed which confines it, and rushes over the basalt ledges of Brier island, and through the Grand passage and Petite passage, with great velocity. Were this tide an ordinary ocean current, produced—say by a trade wind, on entering the Bay of Fundy from the direction from which it does come, it would strike almost directly across the Bay, and would spend its greatest force on the New Brunswick shore between Point LePreau and the mouth of the St. John. Being broken on that shore, the main portion of the current, now much weakened, would set to the eastward, but close along the north shore of the Bay, whilst a slender stream from it would be directed to the westward and eddy about Passamaquoddy bay. We find the very reverse to be the case in fact. The tide, being in its original and simplest manifestation, a vertical uprising of the surface of the ocean, has a tendency to seek *in every direction* its original level. Consequently, when the flood begins to "make" off Brier island, in the mouth of the Bay, the current sets alike in every direction, northwardly and eastwardly. But this being the case, by the time it has reached the New Brunswick shore, it will already have extended up along the south shore, far above the point directly opposite to which it first became perceptible on the north side of the Bay. Thus the tide, both flood and ebb, on the south shore of the Bay of Fundy is always in advance of that along the north shore. It is high water at the entrance to Digby gut twenty-one minutes before it

is high water at the mouth of the St. John, directly opposite. This simple fact explains several curious phenomena of the Bay of Fundy tides.

From the essential nature of a tidal current, it is obvious that the volume of water composing it is cumulative. It is not like a single huge ocean wave which rolls in upon the shore and then retreats. Rather it is like a rapid succession of such waves piling one upon another. In fact it is a cumulation of such waves, following so close upon each other that the intervals between are indiscernible. We have seen that the head of the flood—or ebb—on the south shore is always in advance of that on the north. Owing, then, to this cumulative property, it must always happen that at any given point on the south shore, there must pass over any given breadth, a greater volume of water than will, within the same time, pass over a like space along the north shore of the Bay. This greater cumulation in the volume of water in motion must, other things being equal, cause an increase in its velocity. Accordingly, we find that the velocity of the current on the south side of the Bay of Fundy is always greater than on the north side. On the north side of the bay, from the mouth of the St. John, eastward, the tide runs at the rate of from one and a quarter to one and a half knots. At the same time, along the opposite shore, it runs at the rate of from two to two and a half knots.

This difference in the force of the tidal current between the north and south longitudinal sections of the Bay, continues, but is still more marked in the prolongations of those sections—that is, in the Chiegnecto and Minas arms of the Bay. The increase in the velocity of the Chiegnecto current is very gradual. Just off of Apple river the flood has attained one and three-fourth knots. By the time it has reached cape Enrage, owing to the narrowing of the channel, this has increased to two. Above this, as already mentioned, the Chiegnecto channel is again divided into Cumberland bay and Shepody bay, the channels of both of which gradually contract above cape Merangouin, the point of bifurcation. Consequently, above this point the current in both these smaller bays soon increases to three and eventually to four knots.

We find a very different state of affairs in the Minas arm of the Bay. At the very entrance of the Minas channel the flood has attained a rate of three knots. Its velocity now rapidly increases. It passes cape D'Or and hence on to the much contracted Minas strait, at the rate of six knots. This portion of the Minas channel about corresponds with that part of the Chiegnecto arm where there is a one and three-fourth knot current. Here, about cape D'Or, is the place where a stranger, floating up with the flood, first begins to appreciate the tides of the Bay of Fundy. This six knot current, roaring and foaming in what are called "tide rips" over a submarine ledge extending directly out towards the middle of the Bay, from the base of a magnificent, perpendicular trap cliff five hundred feet in height, forms a picture which, once seen in any kind of weather, is not likely soon to be forgotten. As already stated, this six knot current continues to about the entrance of the extraordinary gorge known as Minas strait. Here, owing to the great and sudden contraction of the channel, its velocity receives another great *impetus*. About mid-channel and between that and the mural cliffs of the Blomidon shore, the tide runs at the extraordinary rate of eight knots, and, under specially favouring circumstances, has attained even ten knots. In the calmest of weather, the waters here seethe, and boil, and whirl along, as if they were in a gigantic cauldron. From the top of Partridge Island, a headland two hundred and forty feet in height, at its eastern termination, I have on a perfectly calm summer morning, seen a number of vessels drifting up the strait with all sails set, performing most singular gyrations, as if the vessels themselves had either become bereft of their senses, or, seeing that there was no wind to enable them to "move on" about their business, had determined to put in the time by indulging in a solemn waltz. But the expanse of waters to be seen from this same point of view often presents a much wilder scene. The name Blomidon is an attempted modern refinement for Blow-me-down, by which this cape was always known in former times, and by which it is still called by old baymen, owing to the prevalence of squalls in its vicinity. For the same reason the water around its base is locally known as "white waters." Off

cape Split there is another fine exhibition of "tide rips" caused by a submarine ledge of trap extending far out into the channel. When there is a high wind and the waves are in motion every where, these "tide rips" are not so discernible as at other times. Their appearance in calm weather bears a striking resemblance to that of some of the most impetuous of the rapids on the St. Lawrence and Ottawa.

There are few visitors to Minas strait who, in order to gaze upon its beauties, would not willingly make their passage through it more lingeringly than the velocity of its tide will permit. On the one hand stretches for ten miles in length, the unbroken range of lofty, wood-crowned, frowning cliffs collectively called Blomidon. At its north-western termination it becomes thinned to a narrow promontory—a bold rock four hundred feet high, cleft from its summit to its base. This split, from which the cape derives its name, being clearly defined, is discernible from as great a distance in either direction as the rock itself can be seen, however faintly. Beyond this a succession of shattered basaltic pillars and lofty pinnacles extend far out into the—here ever-foaming—tide, and terminate in the submarine ledge already mentioned. At the eastern termination of this vast wall, cape Blomidon frowns down from a height of five hundred and seventy feet, with its basaltic parapet wall and its scarp of red sandstone, like an immense bastion placed for the defence of this watery pass. On the other hand there is the bold, semi-circular sweep of Greville Bay, with its warm-tinted, sandstone cliffs, terminating away to the westward, in the hemispherical shaped Spencer's island, and the lofty table of cape D'Or. Carrying the eye eastwardly, it next falls upon cape Sharp, a wedge of trap some three hundred and fifty to four hundred feet high, jutting far out into the strait. Then comes the semi-isolated headland, called Partridge island, already mentioned, and its two cozy, placid little harbours, one above and the other below, with their broad, clean, shelving beach, and the pretty village of Parrsboro' clustering on its further margin. If from this point we complete the circle of vision, it will be to look upon as beautiful a sheet of water as ever tide flowed in, fading away, on the right, into the rich

alluvium of Cornwallis and the Grand Pre, embellished on the left with the exceedingly picturesque group of the Five Islands, and having the distant blue hills of Hants and Colchester for a background directly in front. Tastes differ in such matters; but I doubt if any bit of scenery about the Atlantic coast of North America can be found, which combines so much of the grand with such a charming diversity, as this Minas strait and its vicinity.

A glance at the map will show that the flood tide is poured into the basin of Minas at its north-western corner; and that a prolongation of the northern shore of Minas strait would be almost identical with the actual northern shore of that basin and of Cobequid bay. Hence a perfect repetition of the phenomenon which took place when the flood entered the main bay at Brier Island. But here it is, of course, the *north* shore along which the current takes the lead. Immediately on its entering the basin, there is a diminution in the velocity of the tide in every direction. Its greatest rapidity drops from eight to four knots. All along the north side of the basin it keeps up this latter rate; whilst further south the current setting in the same direction only attains a rate of from two and a-half to three knots. This continues up into Cobequid bay until the channel becomes too narrow for the difference to be observable. It must be observed, however, that on getting up into Cobequid bay, where the bed of the tide is already much contracted and is constantly narrowing as we proceed farther east, we shall find the velocity of the current gradually, but very materially, increased, and exhibiting too, in calm weather, that seething, whirling commotion in the water, already mentioned in speaking of the Minas strait. My own impression from frequent personal observation, although I have no definite proof of the fact, is that, until retarded by the great breadths of sand and mud flats which it encounters near the head of the Bay, the velocity of the tidal current is as great in Cobequid bay as in Minas strait, or very nearly so. On the other hand, in the estuaries of the rivers of East Hants and King's counties, which empty into the southern bight of the Basin of Minas, the tide flows and ebbs in a very leisurely kind

of way, and for reasons which will be obvious from what has been already stated.

I have endeavoured to point out the principal causes which direct the courses and regulate the velocity of tidal currents in the Bay of Fundy, and have briefly described some of their effects. The comparative height to which the tides rise in various parts of the Bay and its inlets, may, in a great measure, be accounted for by the same causes, but not wholly so. A vast deal depends upon the conformation of the channel in which the tide runs. Where the retaining shores converge in such a way as to form a prolonged, straight, and funnel-shaped channel, the flood, rushing up such a channel, acquires an enormous momentum, which *piles up* its waters, we may say, towards the termination of the funnel, to an extent that could not be possible under other circumstances. We find this formation in a marked degree in Cobequid bay. Again in Shepody bay with its prolongation of Petitcodiac river; and again, but in a much less degree, at the head of Cumberland basin. These localities, but more especially the first named, are noted for the extraordinary height of their tides in comparison with other parts of the Bay of Fundy and its branches.

As to what really is the maximum rise of tide at any one point in this Bay, that is a matter upon which authorities differ. Indeed scarcely any two of the Admiralty hydographers agree upon it. The results of all my enquiries and examinations amount to about this: In St. John harbour and Digby gut, ordinary spring tides do not exceed from twenty-seven to thirty feet. As a rule, the vertical rise and fall of the tide increases as we proceed from the mouth of the Bay eastward, towards its head; but the ratio according to which it increases is irregular, being much affected by the width and formation of the channel. From what has been already said, it will appear obvious that in the Bay of Fundy proper, from the mouth up to the point of its bifurcation at cape Chiegnecto, the height of the tide will increase in a more regular, but much less rapid ratio, than we shall find it to do as we proceed up Cobequid, Cumberland, or Shepody bay. It is admitted on every hand that the point where the greatest rise of tide takes place in the whole Bay of Fundy, is at the mouth

of Shubenacadie river, near the head of Cobequid bay. An impression has gone abroad and is popularly taken for granted, that here the tide attains the extraordinary maximum rise of seventy-five feet, a greater vertical rise of tide than is known anywhere else in the world. All the old shipmasters and pilots about the Bay—many of them men of great experience and keen and acute observation—used formerly to declare that this was the case. I do not know what those of their class say now. I find that, taking as a basis of calculation the vertical rise of spring tides at various other points about the bay and basin, as recorded on the latest Admiralty chart, and applying the rule which seems to apply to the tides of Cobequid bay, we are led to the conclusion that the rise of ordinary springs must, at the mouth of Shubenacadie river, considerably exceed sixty feet. I see no reason to doubt that during those exceptionally high spring tides, which take place occasionally under the combined influence of more than one of the heavenly bodies, the maximum rise, at the junction of the Shubenacadie and Truro channels, justifies the popular belief, and does attain to seventy-five feet.

I furthermore think it not improbable that the vertical distance between high water and low water mark was formerly much greater than it is now; and that formerly, at ordinary springs, there was *always* a rise and fall of seventy-five feet at the mouth of the Shubenacadie. The low water level is being gradually raised owing to the fact that the channel is filling up. This applies to all the channels of the head waters of the Bay of Fundy. For instance, not more than twenty-five years since, vessels of from fifty to one hundred and fifty tons used, almost daily, to sail up this Cobequid bay to receive and discharge cargo at the place where it is now bridged, a short distance below the village of Truro. Now nobody ever attempts to take any sort of a craft above the class of an open boat, further up the bay than Yuill's island, which is about six miles below the bridge. The channel is obviously narrowing and becoming more shallow every year. The rapidity with which this is possible, may be imagined from the fact that during springs, one tide flowing over a level space, will deposit a layer of mud a quarter of an inch thick. On the other hand, the

volume of clean river water which used in former times to wash the marine alluvium out of these channels, is every year becoming less, owing to the removal of the forest and the consequent desiccation of the country generally. Upwards of eighty thousand acres of fertile marine alluvium have already been made up by the tides of the Bay of Fundy.

Minas strait, of which mention has already been so frequently made, is about ten miles in length, by from four to six in width. In the very narrowest part, just at cape Sharp, it is less than four miles wide. It seems almost incredible that, in six hours time, a quantity of water can be poured through this narrow gorge equal to a depth of fifty feet over an area of four hundred square miles. Yet this is a not immoderate estimate of what actually does take place four times in every twenty-four hours, during spring tides. It can only be explained by the great comparative depth of this strait. It is a chasm much deeper than the basin above, or the channel below it. The low water soundings, even in the middle of the basin of Minas, only show a depth of from fifteen to twenty fathoms. A series of like soundings through the strait, near mid-channel, show a depth of from forty to fifty-seven fathoms. I can find no record of any such depth elsewhere in the Bay, until we get down to about the longitude of Digby. Whether then we are to attribute it to the eroding action of the water itself, or to that great convenience in cases of difficult explanation, a "convulsion of nature," certain it is that the bed of this strait is a great chasm from three hundred to three hundred and fifty feet deep below low water tide level, or more than double the depth of the basin of Minas; and that, were it not for this fact, the tides in this basin, instead of being greater, would be less than they are in Cumberland basin.

Everybody who has heard of the tides of the Bay of Fundy, has doubtless heard something of that tidal phenomenon locally known as "the Bore." In the Cobequid and Cumberland bays, and in the estuaries of the streams emptying into them, the tide at its ebb leaves exposed immense "flats" of sand and mud, amounting in the aggregate to many thousands of acres in each of these inlets. The more extensive of these flats are composed

almost exclusively of sand; and when they are not separated from the firm land by a channel, or gully, of open water, always have instead thereof a margin of soft, unctuous mud. These sands are always shifting and changing their position, to some extent with every tide; but within a very short time after they are left bare, they become dry and firm—so much so that in walking over them one's boots scarcely leave a discernible track. As they are often miles in extent and as smooth and level as a floor, they would serve admirably for race-courses and for grounds on which to play bass ball, golf, and cricket, were it not for their comparative inaccessibility. There are indeed quicksands in some places; but these are easily discerned and avoided by the initiated. A quicksand is never dangerous if the pedestrian walks smartly over it. I never knew of but one serious accident caused by quicksands. Some years since, a schooner loaded with stone was going down Maccan river, but, being late in the tide, grounded upon Amherst point flat, just opposite the village of Minudie. It happened that the vessel grounded in a quicksand, and sank deeply into it as the tide ran out; but it was taken for granted that she would float again with the flood tide. She did not, however, but remained stationary, filled, and became hopelessly immovable. That doomed schooner continued to sink deeper and deeper, until she totally disappeared, spars and all, and "left not a rack behind."

When the very first of the flood, running with such great velocity as it does, meets with an obstruction in the shape of these flats and the shallowness of the water in the neighbouring channel, an instantaneous ripple is produced. The still advancing and ever accumulating waters in the rear, whose velocity is always greater than that of the first of the flood, having as yet no obstruction, are hurled vehemently forward upon this ripple, which, in a second or two of time, becomes a moving wall of foaming, hissing water. This is called "the bore." The perpendicular height of this advancing tidal wave depends upon the volume of the driving force behind, and the extent and nature of the obstructions in front of it. To the spectator facing the moving mass at right angles, the slope of the surface of the water, from the brow of the wave, upwards and backwards, is plainly per-

ceptible. To ascertain with accuracy the height of what I may call the face of "the bore" seems next to impossible. I have never seen it exceed, according to my own estimation, five or six feet, but it may have been greater; during neap tides it is very much less.

A few minutes after "the bore" has passed, there may be witnessed another phenomenon of the rising tide scarcely less startling and grand than "the bore" itself. I allude to the "tide rips;" for there are tide rips upon these sands as well as upon the ledges farther down the Bay. They result from the same cause as "the bore" does. The advancing tide has acquired greater volume and greater velocity; but yet meets with shallows which impede its progress. The surface breaks into tumultuous waves which continue until, partly from tearing up the sands in the bottom and partly from the rising of the tide, the shallow is overcome. Suppose a spectator, unaccustomed to such scenes, to be on a calm day watching the coming tide from a good position. "The bore," has just roared and foamed past him, and its noise is now thrown off in another direction. There is silence except for the slight gurgling sound of the after current pressing on with tremendous rapidity. Suddenly he is startled with a roaring of waters as loud as that of "the bore" itself was a few minutes since. Looking for the cause of it, he perceives that where only two or three seconds ago the surface of the water was as smooth as glass, it is now, to an extent of many acres, a mass of tawney foam, tossing in the wildest commotion, as if a submarine volcano was about to emerge from the spot. Then it breaks into regular, but terribly energetic waves, the crests of which almost touch each other. Whilst he is admiring, or wondering at this strange phenomenon, his attention is attracted to a similar commotion in another direction; then another, and another. In each instance, after a lapse of from five to fifteen minutes, the turbulence of the waters subsides just as suddenly as it arose, and the flood sweeps on as smoothly as a torrent of oil.

Tourists cross the Atlantic to see the Falls of Niagara and the Rapids of the St. Lawrence. I cannot but think that the tides of the Bay of Fundy are scarcely less worthy of their attention.

But to see these tides in their true grandeur and beauty, the spectator must be in their midst. About the full or change of the moon he must get on board a vessel, drop down with the ebb, and get aground upon some of the broad flats about the middle, or lower part of Cobequid bay, and wait there for the coming flood. I have endeavoured to describe the scene as it would appear to him in daylight. Perhaps the occasion is even more impressive in a still summer's night. In the dead silence of the night you hear a low, prolonged whisper. What can it be? You listen intently. It grows louder. It is the "solemn roar" of the tide, miles and miles away. Every minute you are conscious of the tumult away out in the darkness yonder, growing louder and approaching nearer. It is difficult to prevent the imagination getting excited and the mind being deeply impressed with awe. On it comes like a Fate, and still you know of its approach only through the organ of hearing. At length, in the dim light you see a white streak, reaching from shore to shore, or from the gloom on the one hand to the gloom on the other. It is "the bore." It rushes and roars on, striking the as yet firmly embedded vessel in which you are luckily safe from its embraces, with a thud which makes its timbers quiver; and is past. Then, after a breathing space, the tide rips begin to make. Here, perhaps, near at hand, you can see their foam leaping up under the starlight, but you can certainly hear their fitful roaring out in the darkness in every direction. Where not many minutes since the silence was, it may be, so intense that you could hear yourself breathing, you now find yourself in the midst of a chaos of angry waters.

The momentum of this "bore" is no doubt enormous, but many stories that are told of its achievements, and indeed of the Bay of Fundy tides generally, are quite apocryphal. So many strange reports have gone abroad about this Bay, that to many strangers it is a name of terror. Yet to those acquainted with the place its navigation is comparatively safe and easy, and these very tides are what conduce so much to the facilities of its navigation. Many of nature's moods and changes there are known, can be calculated upon before hand, and taken advantage of. I have myself gone all around and over the basin of Minas

and Cobequid bay in a little open sail boat. I have seen men from twenty miles up the Shubenacadie river, away down the bay nearly to Economy point, in log canoes, fishing. And I have seen Indian bark canoes crossing the bay near cape D'Or. Still it must be admitted that the Bay of Fundy is no place for a stranger to be without a good pilot. Finally—as to the dangers of navigation there—I will hazard the assertion that the number of marine disasters in the Bay of Fundy is less than on the same extent of coast in any other part of Nova Scotia.

Art. V. On Trichina Spiralis. By George Lawson, Ph. D., LL.D., *Professor of Chemistry and Mineralogy, Dalhousie College.*

(Read Feb. 4, 1867.)

In this paper the author described the structure and developement of *Trichina Spiralis*, drawings of which, and specimens under the microscope from the human subject were exhibited. It was stated that although careful search had been made, no trichinæ had been found in pork exposed for sale in the Halifax markets.

Several other *Entozoa* were referred to, and a description given of *Tænia pectinata*, which occurs in the intestines of the porcupine in great quantity, both in Canada and Nova Scotia. Specimens were shown.

Art. VI. A Fortnight in the Backwoods of Shelburne and Weymouth. By J. Matthew Jones, F. L. S.

(Read Feb. 4, 1867.)

A fortnight seems but a brief space, yet much may be done and seen in that time. Some few years ago, on my first arrival from England, I had the good fortune to join an expedition sent to report upon the state of the timber on the admiralty reserves in the western part of this Province, and I was introduced for the first time to the pleasures of a forest life in a snug little camp, pitched in a charming nook beside the limpid waters of the ever winding Roseway, a short distance to the northward of Shelburne. It would be useless for me to dilate upon the feel-

ings of one, who fresh from the cultivated vales of old England, finds himself suddenly placed in the midst of the "forest primeval," with no sounds of civilization to mar the sweet stillness which reigns amid these western wilds; and especially upon those of a naturalist, who loves to look upon nature in her pristine garb; to see the land untouched, and the trees and shrubs in every stage of life and decay, just as they have lived and died through succeeding ages; to listen to the unknown sounds and cries proceeding from animals and birds, and participate in the many other events hourly taking place as he journeys on through these trackless solitudes; for it may be truly said that his cup of pleasure is filled to overflowing, and every moment of his time occupied in marking and studying the changing scenes which at every step burst fresh and enchantingly upon his wondering view.

It was on a fine summer's day towards the close of the month of August, a date which will ever remain stamped on memory's pleasant page, that, accompanied by two worthy representatives of Her Majesty's forces, naval and military, I was ushered into the camp of which I have spoken. We stood upon the bank of a rippling stream, and the first object that caught the eye was the stalwart form of the camp steward, wielding an axe with such power and effect as to make the huge log he was splitting for the night's fire shiver under the strokes, and cause the surrounding forest to ring with their echoes; while near a fire burning briskly between two granite rocks, stood the form of a veritable Indian, reclining in indolent ease over the burning brands, above which hung the stock pot from which the steam was puffing, sending around a goodly smell which made the appetite sharpen as we thought of the eatables within. And then the camp itself; a rough affair it looked—two slender poles some ten feet or so apart, placed upright, a cross pole lashed to them a few feet above the ground, then with their buts resting on this cross pole, and sloping back to the ground, were laid other poles and branches of trees, fern, &c., strewed all over the whole, forming a roof, which, although not waterproof, helped to keep off the falling dew at night. The sides were filled in with twigs and brushwood, while the floor of this primi-

tive domicile was covered with a thick layer of spruce branches, the smaller sprays on top to render the couch more comfortable, and then the occupant had to spread his blanket and make himself as much at ease as circumstances would permit. So we commenced our forest life.

From Roseway river camp we journeyed to the northward, and camped again on a small point of land which jutted out into a large lake called "Long island lake," and a prettier spot could scarce be conceived. Before us lay the lake whose mirror-like surface scarce ruffled by the breeze, was dotted over with small islands, clothed with spruce and pine, while the evening sun, hot and powerful, reflected their shadows far down in the depths below, and as the shades of evening drew around, and the orb of day sank in majestic splendour behind the dark mass of forest to the westward, the camp fire began to cast a ruddy gleam of light upon the surrounding objects. The fog now rising from the lake, caused a chilly feeling to creep over us, and more wood heaped upon the burning brands, caused the sparks to fly up like miniature rockets in space, while massy flames poured out from our pile of bulky logs, until bursting up in one grand sheet of blazing light, it dazzled with lurid glare the neighbouring forest, and our company all seated around the seething mass busily consuming the evening meal.

From this camp we one day made an excursion to the eastward, in the neighborhood of Jordan river, and found the whole district to be densely wooded with hemlock, spruce, and pine. Indeed of these species of *conifers*, the forest in the vicinity of Shelburne appears to be almost wholly composed, and it is not until you arrive some fifteen miles up the country, that groves of maple and oak are seen. The country around Shelburne bears evidence of the ravages of fire several years ago, the present growth of timber being but small.

An island of an acre or two in extent, stands about the centre of Long island lake, and is known as "Indian island," from the fact that in years gone by, the Indians, who had a stationary camp above this lake, buried their dead here. And surely no fitter resting place could have been found for those children of nature, than here beneath the sombre shade of pine or spruce,

to take their last long sleep, in the full hope of awaking in the happy, yet visionary hunting grounds they suppose to lie in a brighter and better world beyond the sky. It would appear that the Indians have almost entirely left this part of the Province, for only two or three live in the district, one of whom, named *Peter Paul*, accompanied our party the whole way to Weymouth, and proved himself as generous, noble hearted a fellow as ever smoked the calumet of peace. To the absence of Indians may no doubt be attributed, in a great measure, the large number of bears, and the presence of beaver in the vicinity of the granite hills, mid way across the country, called by some the Blue mountains; but more of these presently. From this camping ground we journeyed along the road which led to the district of Sugar Loaf hill, a fine grove of hardwoods, birch, beech, oak, and maple. It was on the further side of this hill that we bade adieu for a while to civilization. Embarking in a rather frail boat upon a lake, we pulled, not without sundry misgivings as to the probable termination of the voyage, for some low marshy ground on its northern shore, and happily succeeded in reaching the mouth of a small river, up which we had to go; but we had not gone very far before we found that our bark must be lightened, and all jumped out and pushed her up the shallows, until we came to a large open savannah of considerable size, on which grew luxuriant grass. Few trees were to be seen about here, and those of a very stunted growth, the most common being the alder. Leaving our boat about mid-way through the plain, we shouldered our packs, which were far too heavy, and made for the north-west end of it, where we entered the thick forest again. Peter Paul having called a halt, addressed us in a very fatherly manner to the effect that we had better look to our weapons, for as he said, "you don't know what be about where we are going." Having complied with his request, we started afresh, and after some pretty bad travelling, arrived about sundown at a small lake at the southern base of the granite plateau. Here we found an old log hut which had been erected some time back by lumberers, and made it our home for two or three days, while we surveyed the country around. This lake from the quantity of small flat stones around

its margin, was called "Whetstone lake." The southern shores of this lake are clothed with a heavy growth of timber, which appears to have escaped the extensive fire that raged over the whole extent of the Blue mountain range. The timber is composed of hemlock, spruce, maple, and birch, with an underwood of withrod, and near the water an abundance of fern of two species, the larger being the well known *Osmunda regalis.*

We may here remark in passing that our Provincial maps are in fault in regard to the route we took, for not a lake or river is marked upon any of them in that quarter, whereas the country abounds with lakes and streams, some of good size. We travelled as near as we could north-west from Shelburne, but owing to the swamps and lakes we had to deviate at intervals. The land from the district of Long island lake is very level, and from what I could judge, is capable, when cleared, of extensive cultivation, particularly that portion in which is comprised the open savannah I have mentioned.

Our first excursion from the camp at Whetstone lake led us to the rocky slope of the Blue mountains, which lay in full view before us, and on reaching the elevated ground, one of the Indians sighted a bear which was quietly ambling along among the blueberry bushes, regaling himself on the ripe and luscious fruit. It was at once decided to stalk him true highland fashion, and off we set. The Indian, arriving within range first, sent a bullet through one of his feet, as we afterwards found. Turning round, the fellow made right at C——— and myself, standing together some forty yards below. On he came with a growling noise, and when close to us showed a fine array of teeth, which we would have preferred viewing after his decease. There was nothing for it, however, but to stand our ground, when 'crack' went my friend's ponderous Lancaster, and with it the massive conical ball which caused poor bruin to change his course, for with a bound he swerved to the right and was lost in a thicket of birch and alder. Proceeding cautiously along, we found him at last stretched out in a little hollow, and a huge beast he was, measuring from tip to tip seven feet two inches. We must here mention a curious fact which we consider worthy of note. On running hurriedly along from boulder

to boulder, we slipped and fell through a hole, with the knee cap against a rock. The knee instantly swelled up and gave great pain, and we could barely drag along, when one of the Indians said if rubbed with bear fat it would soon be right again. When skinning the animal he cut off a piece, and we rubbed the part well, and singular enough in a quarter of an hour the swelling subsided almost as quickly as it had risen, and we were enabled to walk back to camp. The Indians have a very ready way of transporting bear meat—cutting it up in small pieces they fold up the bear skin neatly with the pieces within, and then tie the whole with bands of withrod (*viburnum*,) and with the same bands secure it across their shoulders as a pack, leaving the arms free for action. Bears were numerous at this spot, and were no doubt attracted by the vast quantities of ripe berries, particularly the huckleberry and blueberry, the (*Gaylussachia resinora*) and (*Vaccinium Canadense*,) the former in astonishing abundance. The trees and shrubs which clothe the sides of this rocky range are principally dwarf birch, (*Betula nigra, and B. papyracea*,) alder, (*Alnus viridis*,) interspersed with spruce (*Abies alba and rubra*) and dead pine (*Pinus strobus.*) Under stones in Whetstone lake I found several small leeches, (*Hirudo*,) one of which was of a white colour. The larvæ cases of a caddis-fly, (*Phryganea*,) were abundant composed of pieces of weed and granite sand. We noticed that the bird droppings, which were upon almost every boulder on this range, were of a dark blue colour, caused no doubt by their feeding at this season almost wholly upon the berries of the blueberry and huckleberry. The shores of Whetstone lake were covered with a beautiful granite sand, nearly white.

As we are now in the most famous district in the Province for bears, perhaps it will be well to make a few remarks upon the natural history of the black bear, (*Ursus Americanus.*) The bear comes out of his winter den as soon as the snow disappears, generally about the end of April. The he bear dens by himself. The she bear cubs about the first week in February, and the young are at first about the size of a common squirrel, (*Sciurus Hudsonius.*) They obtain nourishment from the mother

until about the latter end of June, and den with her through the next winter; remaining with her till two years old, and leave her for good when she leaves her den the second spring after birth. Bears are fat when they leave their dens in spring, but soon get poor, finding but little food at that time of year. It is at this time that they are apt to commit forays upon the flocks of the back settlers. These animals are known to sit and watch at the falls of streams for fish passing up in spring. Their principal food, however, consists of the wild fruits of the forest, ants, hornets and wasps and bees, whose nests they invade for the purpose of securing the larvæ, wax, or honey within. They care nothing for the stings of the infuriated hornets and wasps, but the cubs cry out when stung, but nevertheless keep fast hold of the comb. Cubs will not fight with the mother when she attacks any one, but run up trees. Rutting time is in June when the he bears are very savage, sometimes going in gangs of twenty or more, and when they come near a she bear they commence fighting among themselves furiously, making the most hideous roarings all the time, and if one gets killed in the fray the rest fall upon him and eat him. They fight by first rising on their hind legs and rushing at each other, hugging, biting and scratching, endeavouring to rip their antagonists' stomachs open with their hind claws. Bears shed their coats about July. They stalk young moose by creeping upon them, and when close to make a great spring. Having killed the moose they skin him just as clean as a man would, and begin to eat the chest first, tearing out the paunch which they throw away. They dislike wet weather, and take shelter where they can keep dry under rocks, &c., and other places. When the old bears go into dens in the fall, they take plenty of dead leaves and fern, and make a good bed of them, and the she bear makes no further provision at cubbing time. They always return, if alive, to the same den each fall, but if a porcupine takes possession while they are away in summer, and leaves droppings about, the bear will not return to that den again. A large size bear will weigh over six hundred pounds, and give one hundred pounds of grease, for which one shilling sterling per pound is given at Shelburne, while at Halifax a wine bottle full sells for

four shillings. The meat of the bear is excellent eating, tasting something like mutton. It is best boiled to render it tender, and then fried with pieces of the fat. The tongue is very similar to a calf's tongue when boiled. The Indians cure bear meat by cutting it up into long strips and placing it on a frame work of poles, lighting a fire underneath so as to dry it in the smoke, which process takes about two days, and if kept dry afterwards in a proper place will keep for a year or more. They never make use of the inside portions of the animal, viz.: heart, liver, &c. When they cook fresh meat they cut it up into small pieces and fry it. The meat when partially smoked we found much better boiled than fried, frying making it too hard. The bones of the bear are salted down and used to put into soup. The gall of the bear the Indians use for sprains and wounds.

The Indians appear to be a very superstitious race of beings, and the most trivial events cause anxiety. For instance, one night the light of our fire attracted a little Acadian owl, (*Strix Acadica*,) which perched on a branch close by, making its curious noise. One of the Indians at once predicted that bad luck would attend our expedition, and begged us to level a gun at the unfortunate bird, whose death alone could cast away the spell that rested upon us.

One day we started with Peter Paul in a westerly direction from the camp, and after travelling about two miles through thick forest and swamps, we arrived on the borders of a good sized lake with an outlet at its western end. On walking round, we came upon a large beaver house, situate on the lake edge, where the water was deep. The house appeared as if two cart loads of faggots had been thrown down in a heap and flattened above. Having no implements to enable us to take it asunder, we were obliged to leave it as it was. Going still further down the lake side we arrived at the outlet, which we found dammed across by the beavers. It was constructed of sticks and mud, overgrown with grass and weeds, the sticks laid over each other in a line of lace work, almost entirely stopping the escape of the lake water down the brook. There was an older dam below this one about fifteen yards lower down the brook. The smaller

alders, poplars, and other trees near the dam, were cut short off near the ground. This lake on its west side is muddy, with a vigorous growth of rushes, sedges, &c. An island of about half an acre, covered with spruce and pine, divided from the south shore by a narrow passage, has upon its eastern side a very large beaver house upon the shore, extending into the water. The house, or rather stack of sticks, is very large, built of larger sticks than usual. In this great pile there must be several cart loads of sticks and small logs, from the small twig up to pieces four inches in diameter. Some pieces are several feet in length, while others are only three or four inches long. The beaver pups early in spring, having two cubs, but they are sometimes known to have young in August. When the cubs are two years old they pair and go off to another place. Beaver skins sell about Shelburne now for four shillings sterling per pound, while some years ago they sold for eighteen shillings per pound. A good skin will weigh four pounds.

About Whetstone lake the robin, (*Turdus migratorius*,) was very common, flocking together in large numbers at sundown on the shore, picking up insect food. The hermit thrush, (*T. solitarius*,) well named so from its retired habits, occurred there also, treating us as the shades of evening drew around, to its plaintive note; and the spotted snake, (*Coluber sirtalis*,) was fond of sunning itself on the granite boulders by the lake side, about mid-day. These boulders had been carried up from the lake to their present position by the action of ice, for the course they had travelled was clearly perceptible in the deep channel which led from each of them to the bed of the lake.

After three days spent in this locality, we made a move to the north-west, but had not proceeded far before some of our party shot another bear, and we had to call a halt in order to skin him. We had now arrived on the upper ridge of the granite plateau, from which we had a magnificent view of the country around for many miles on every side. And a wild and curious scene it was. All around us lay a perfect wilderness of granite boulders, from among which rose a dense growth of the blueberry and huckleberry, and interspersed with thickets of dwarf spruce, birch, and alder. The Labrador tea, (*Ledum latifolium*,) and

a species of *Myrica*, were also abundant. Small lakes were seen in every direction, and the shrill cry of the loon (*Colymbus glacialis*,) marked the breeding place of that shy and solitary bird. Our camp here was an exceedingly primitive one—a few small poles stuck against the side of an overhanging boulder, and covered with brushwood, was all that gave us shelter, but the day's toil sufficed to send us into a sound sleep, which was only broken by the sharp frost of the early morning. On awaking early I went out to survey the scene, which was indeed lovely in the extreme. The sun was just rising, illuminating the eastern sky with glowing colours; a flock of waxwings (*Bombycilla Carolinensis*,) sat preening their feathers on the bleached branches of a blasted pine hard by, in company with a few migratory thrushes, while a keen north-west wind was blowing, bracing up the nerves, and the whole country round became gradually lit up to the life of another day.

We now travelled still upon the elevated table land, passing here and there through some terribly swampy ground, covered with moss, which sunk at every step, letting us up to the knees. We were freighted with our heavy packs, and above all the heavy green bear skins, and the work told upon all. Sometimes our route lay over spots where, in addition to the mossy swamps, fallen spruce and pine lay beneath with their dead sharp-pointed spikes of branches sticking up, on which we occasionally got a painful reminder; but after all our trouble, about noon we gained the summit of a high point of land, on which rested a huge granite boulder, split into two pieces, under which was a large well of delicious water. We gave this the name of "Split Rock well." Leaving this place, we arrived a little before sundown, near a stream which joined two large lakes. The stream was deep and about twenty feet wide, and presenting a good site we camped here. But at dusk three of us started for the upper lake to see the beaver which Peter Paul told us he had seen there some time back, when in company with an old Indian he had visited it. We came cautiously upon its banks, and lay down, looking and listening for the animals. In a short time, at some distance, we could see in the twilight, ripple marks on the surface, and presently a head or two moving about swimming

in the direction of the opposite shore. We watched them carefully and observed that the beavers coasted along shore, engaged now and then in looking for food, just as we have often seen the water rat of England do in a pond. After watching them for some short time, we heard on our right where Peter Paul had gone, a loud flap on the water, just as if a paddle had been struck on the lake, and all signs of beaver vanished at once. This we considered came from a sentinel beaver who, having heard Paul coming in the direction of their head quarters, had sounded this tocsin of alarm. Although we waited for some time after this not a beaver could be seen.

The next day we travelled also along the table land in a north-west direction, passing over much the same kind of land, the spruce woods getting larger. I chased a porcupine for about a hundred yards, when he took to a spruce tree some twenty feet high and was killed. I noticed that the Indians shaved the porcupine of his quills before carrying him. The process is as follows:—taking a sharp knife, they shave from tip of tail to head, and are extremely careful not to get any of the small quills in their hands, as the puncture is very painful. The old woman's tale of a porcupine throwing its quills at a person chasing it is untrue; the truth of the matter being, that if a stick be presented to it, or any one attempts to handle it, it immediately strikes the offender with its tail, driving the smaller quills with such force as even to stick them firmly into a piece of wood. The flesh of the porcupine is delicious, tender and sweet, the tail when fried nicely being the choicest morsel. We camped this night in dense woods by the side of a stream, and having exhausted all our provisions, began to feel somewhat alarmed that if we did not reach the settlement on the west or Weymouth coast before long we should fare badly. I may say that we fully expected to have struck some marks of civilization at noon of the first day according to our reckoning, but on sending an Indian up the highest trees, during the afternoon, he only gave us the unwelcome intelligence, "no sign clearing, big woods all along." The next morning early, we were determined to try our best to get out of our dilemma, and so it was decided that we should stow away all our goods and chattels,

and leave them covered up with branches, so that if we got out all safe we might send in for them afterwards, there being but little fear of robbery in such a situation. We therefore took with us only a blanket and our guns, and being thus lightly burdened we made good way. But after a long and tedious march until mid-day we could strike no blaze, (*i. e.*, the marks placed upon trees by surveyors in the back settlements,) and we sat down to rest and devour our last scrap of biscuit and a small tin of chocolate among six, with anxious thoughts as to what would constitute the next meal—off again, we traversed through thick woods, descending all the time, and in a valley first discovered an old blaze, which gave us fresh courage, and we contrived to follow it for some distance, until to our horror we arrived on the shore of a large lake, about midway from its extremities, so there was nothing for it but to trudge, wearied as we were, all round its lower end, which having been accomplished, we struck out through the forest again by compass, no blaze being seen. It was getting dark, and we had given up all hope of getting out that night, when Peter Paul, who was some distance ahead, called out, "road, road!" and on arriving at the spot, sure enough there lay an old track, which following to the southward till dark we came to an open spot surrounded by woods, in which was a field of turnips and potatoes. We may be excused when we say that we dispensed at this time with the ordinary courtesies of society and allowed every one to help himself, and a ludicrous sight it was to see six hungry individuals sitting in the midst of a turnip patch refreshing themselves on the vegetable esculents. An old shed, with large holes in the roof, stood in one corner, and we adjourned to this, and making a fire, roasted potatoes and made ourselves as comfortable as we could, but the rain began to pour in torrents, and drenched and lightless we passed a weary night. The morning, however, no sooner dawned than we trudged down the road, and hearing the sound of an axe we directed our course that way, and soon found ourselves in the presence of a worthy settler, whose snug farm house lay close by on the banks of the Sissiboo river, Digby Co. A forlorn looking group indeed we must have appeared, all tattered and torn as we were, after our hard travel over

mountain and swampy barren; but the heart of the worthy Nova Scotian warmed towards us as he hurried us along to his dwelling, and soon with his table groaning under the weight of good fare, he bade us welcome to civilized life once more, and it is almost needless to add, that while enjoying such welcome hospitality, we soon forgot the weary tramp we had had during that ever memorable "Fortnight in the Backwoods of Shelburne and Weymouth."

Art. VII. Notes on the Weather at Halifax, Nova Scotia, during 1866. By Colonel Myers.

(*Read March* 4, 1867.)

January. The four first days of this month were mild, but dull and rainy. On the 5th a sharp frost set in, which lasted till the 9th, the thermometer standing during the night of the 6th, 7th, at 15° below zero. The remainder of the month was in general fine and moderate. Mean temperature 20° being 2° lower than that of the same month last year, and 5° below the average of the three preceding years.

February began with very cold weather. On the night of the 6th, 7th, the thermometer indicated 7° below zero, and on the 8th the harbour was sufficiently frozen to admit of persons crossing over on the ice, the ferry boats being unable to ply. On the 11th a rapid thaw occurred, and the ice broke up on the following day. The weather to the end of the month continued mild for the season, with some high winds from the southward, and rain. Mean temperature 25°, being 1° above that of 1865, and of the average of three preceding years.

March was ushered in with a strong gale from the north-east, but of short continuance. The month was generally cold and disagreeable, and towards the end of it very stormy, with snow and rain. Mean temperature 29°, 5° below that of 1865, but corresponding exactly with the average of three preceding years.

April. Some stormy weather at the commencement of this month, and a heavy gale from south-west on the morning of the 25th, but the month generally fine. Mean temperature 40°, the same as last year, but in excess of the average of three preceding years by 2°.

May. This month was characterized by cold and backward weather, with much rain and occasional snow squalls. On the 7th the North-west Arm was skimmed over with ice. Mean temperature 47°, was 7° below that of the same month last year, and 1° below the average of the three preceding years.

June. Rain fell on twelve days during this month, but for the most part in light showers, and the weather was in general fine and warm. Mean temperature 56°, being 2° below last year, but exactly agreeing with the average of the three preceding years.

July. Calm fine weather prevailed during this month. It was remarkable in the United States by long continuance, as well as for intensity of heat. Within a period of eleven days the thermometer rose five times to 95° and upwards, reaching at New Haven, on the 13th, to 103¾° in the shade; the highest temperature known to have been observed at that place for eighty-nine years. Here the highest noted was 87° on the 13th, the mean temperature being 61°, 1° in excess of 1865, and 1° below the average of three preceding years.

August had more rain than usual, but there was some beautiful weather during the month. Mean temperature 62°, 1° below 1865, and two below the average of the three preceding years.

September. Much unsettled weather this month, with heavy rains, but remarkably free from the high winds which often prevail at this period of the year. Mean temperature 58°, 1° above that of last year, and the average of the three preceding.

October. A beautiful month, clear and dry during three weeks, very favorable to farm work. The fine weather began to break up in the last week, when it became cold and stormy, with rain and sleet. Mean temperature 45°, 1° above 1865, 2° below the three years average.

November. Generally fine, and free from stormy weather till towards the end of the month, when gales occurred. Mean temperature 38°, being 1° below that of 1865, and the three years average.

December. The ordinary winter weather prevailed this month, with more snow than usual. We were visited by a sharp gale from the south-west on the 23rd, and a still heavier one

from the south-east, on the 27th. Our neighbours in New Brunswick and United States, appeared, from newspaper reports, to have suffered more severely from these gales, than ourselves. Mean temperature 28°, 4° above 1865, and 2° above the three years average.

The highest temperature noted in the shade was 89°, on 26th June.

The lowest temperature noted in the shade was 15°, night of 6th, 7th, January.

The highest monthly range, 59° in February.

The lowest monthly range, 31°, in August.

The range for the year, 104°.

The hottest month was August. The coldest January.

The mean temperature of the year 42°.

The highest reading of the barometer during the year was 30.36, on 17th February.

The lowest reading of the barometer during the year was 28.79, on 2nd May.

The mean for the year 29.62.

The highest monthly range was 1.24, in April.

The lowest monthly range was .32, in February.

The yearly range 1.57.

The most prevalent winds during the year were north-west and south-west.

The least prevalent winds during the year were east.

Rain fell on 134 days.

Snow fell on 52 days.

Hail fell on 3 days.

Fog prevalent on 61 days.

Auroræ Boreales were observed on 33 nights.

Solar halos were observed on 8 days.

Lunar halos were observed on 12 nights.

Thunder storms occurred on 22d April, 28th June, 4th, and night of 23d, 24th, August, and 23d November.

Lightning was seen, but no thunder heard on 6th July.

Thunder heard but no lightning seen 20th June, 8th, 10th, 13th August, and 22d September.

A fine Parhelion was visible for about an hour, from 5 o'clock, p. m., on the 9th June.

The latest snow in the Spring, fell on 15th May. The earliest seen in the Autumn, was on the 14th October.

Winter. The mean temperature of the winter of 1865—1866, deduced from three daily observations, was 23°, with a range of 67° from 15° below, to 52° above zero.

The mean pressure of the atmosphere was 29.66, with a range of 1.85 from 28.51 to 30.36.

Rain fell on 23 days—three in excess of the average of the three preceding years. Snow fell on 26 days—three less than the average of three preceding years.

Spring. The mean temperature of the spring of 1866 was 39°, with a range of 60° from 10° to 70°.

The mean pressure of the atmosphere was 29.52, with a range of 1.45 from 28.79 to 30.24.

Rain fell on 37 days—three in excess of the average of three preceding years. Snow fell on 17 days—six in excess of average of three preceding years. Hail fell on 1 day.

Summer. The mean temperature of the Summer was 60°, with a range of 50° from 39° to 89°.

The mean pressure of the atmosphere 29.61, with a range of 76 from 29.13 to 29.89.

Rain fell on 38 days—exceeding the average of three preceding years by five.

Autumn. The mean temperature of the Autumn was 47°, with a range of 51° from 23° to 74°.

The mean pressure of the atmosphere was 29.69, with a range of .84 from 29.24 to 30.08.

Rain fell on 37 days—one in excess of the average of the three preceding years. Snow fell on 5 days—one less than average of three preceding years.

An examination of the table (to be found in the Appendix,) of the mean temperature and atmospheric pressure of the several seasons during the past four years, together with what has just been stated, will at once show how very little each season varies year by year. The winter is seldom too rigorously cold; the unpleasant weather, which sometimes occurs in spring, is not of long continuance, while the summer and early months of the autumn are, with rare exceptions, invariably delightful. Indeed Halifax with its fine healthy climate—with its facilities for the

erection of bathing establishments, so much needed,—and with the many inducements it already has, or might be made to possess, cannot fail, by and by, when the extension of railroads will render it more easy of access by land, to attract not a few of the many excursionists, who annually flock to the north to escape from the extreme heat of their southern residence.

On reviewing the past year it appears that part of the winter of 1865–1866 was of more than ordinary severity. On the night of 6th–7th January the thermometer fell to 15° below zero, not having reached a lower degree than 10° below zero during three preceding years; but the mean temperature was only 1° below that of the same period. It is remarkable, with regard to the freezing over of the harbour, as noted in February, that what a temperature of 15° below zero in January failed to accomplish, was afterwards, in February, effected when the thermometer indicated only 7° below zero; but it must be borne in mind that the combination of two conditions of the weather is required, viz: a perfect calm with a certain low state of the temperature, without which the harbour does not freeze; and to this may perhaps be attributed the infrequency of what was witnessed last winter; such an event completely interrupting the navigation of the harbour, not having, as far as I can ascertain, occurred oftener than five times during the past 55 years, viz: in February, 1866, 1859, 1839, 1834, 1821.

The Spring, though cold and backward, was not altogether unfavourable to the farmer. The summer was remarkable for its intense heat in some parts of this continent lying to the westward of Halifax, especially the month of July, as previously noted, but here the mean temperature did not exceed that of three preceding years. There was more rain than usual. The hay harvest, to those who were fortunate enough to house it early, was good; but the weather proved unfavourable to the later crops, and much was got in in a bad condition, and much entirely lost—other crops promised well at the end of summer; but there was a change at the commencement of autumn, and the very unsettled rainy weather of September, seemed for a time to endanger them. A fine dry October, however, removed all anxiety, and the generally good harvest was at last

the subject of much thankfulness. The days of rain in 1866 were two less than 1865, but the quantity that fell must have been greatly in excess, though not possessing nor having had access to an ombrometer or rain-guage, I cannot speak with accuracy. There were some heavy freshets which did much damage throughout the Province. There were twenty gales of wind during the past year, for the most part moderate, and lasting but a few hours. Auroræ boreales were of less frequency than usual, and deficient in brilliancy and beauty. The few thunder storms that occurred were neither violent nor of long endurance. There were also fewer halos than recorded in former years.

The following periodic phenomena were observed during the year. March 13th, small "song sparrow" heard to sing,—14th, lilac buds beginning to develope themselves in gardens in town,—17th, huckleberry in bud,—18th, full blown mayflower plucked in the Tower woods,—25th, flock of seven wild geese observed going south-east,—31st, lilac in bud at the Dutch village.

April 7th, robin first heard singing,—9th, frog (*Rana fontinalis*) first heard to croak at 2 p. m.—14th, blue hawk seen about poultry yards, and water spider on ponds,—15th, clover in leaf,—16th, swallows first seen at the Dutch village,—18th, golden-winged woodpecker chuckles,—19th, first peep of the frog (*Hylodes pickeringii*) heard,—22nd, hermit thrush first heard,—29th, scutch grass five inches high; crowfoot, dandelion, dock and strawberry in full leaf.

May 1st, hacmatac and withrod bursting into leaf; humblebees about,—3rd, king-fisher at Downs' pond; white violet in flower,—6th, wild rose coming into leaf,—10th, black flies appear and very troublesome on the 12th,—13th, strawberries in bloom,—25th, French willow in leaf and flower,—27th, spider webs shew on dewy mornings,—28th, balsam poplar in full leaf; dandelion in seed,—29th, wild cherry coming into blossom.

June 21st, white weed in flower.

October 6th, ash and birch leaves killed by frost; maple leaves begin to turn in moist spots,—18th, black birch leaves begin to turn,—24th, leaves of the beech all turned brown,—

25th, shore lark in flocks about Halifax; all the leaves of the red maple off,—27th, beeches stripped of leaves.

Nov'r. 1st, leaves of apple trees still green,—3rd, hacmatac leaves all turned yellow.

I cannot close these remarks without adverting to the grand meteoric display which was the object of such universal expectation last November, unhappily to be disappointed here by the prevalence of cloudy weather at that interesting period. The night of the 11th November was hazy; that of the 12th overcast, with heavy rain, which encouraged a hope that it would clear off before the next night,—the eventful 13th, 14th,—but no; for cloudy and overcast weather was continuous till the 17th. Judging from my personal observations, the atmosphere on the night of the 13th, 14th was densely opaque, not affording the slightest glimpse of what was going on above. The local newspapers reported a few meteors having been seen through occasional breaks in the clouds, but nothing worthy of note. From accounts received from places more fortunate, we were made keenly sensible of what we lost in not having been permitted to view the wondrous display. At the Royal Observatory, Greenwich, no less than seven thousand meteors were counted between 11 p. m. of the 13th, and 5 a. m. of the 14th—of which four thousand occurred between one and two o'clock a. m. of the 14th. The London "*Times*" of 15th November noticed that an observer at Highgate, from a window of circumscribed view facing north-north-east, counted one hundred meteors in the four minutes between 12.32 and 12.37, and two hundred in the two minutes between 12.57 and one o'clock a. m. of the 14th. The meteors were of various colours, orange, green, &c., their trails of a bluish cast; their paths of divergence apparently from a point within the constellation "Leo." Their course generally irregular; those which shot from east to west seemingly larger and more brilliant than the others.

It would be foreign to this unpretending paper to discuss the various theories concerning meteors which have from time to time been advanced and discarded—of their origin and nature, and of the laws by which they are governed, much has yet to be learned; but of the accuracy of the prediction of the return of

showers of meteors every thirty-three years little doubt can now be entertained. The confirmation of these forecast last November, with the fine opportunity afforded in England for observing the phenomenon, will, it may be hoped, assist science in further unravelling the mystery in which these erratic bodies have been shrouded, from the ages of ignorance and superstition when they were looked upon with terror as portents of coming evil, to the present day, in which they are better understood; but whatever may be the addition to the knowledge already possessed of these wonderful bodies to be obtained from the numerous simultaneous observations taken on the night of the 13th—14th Nov. last, man will find himself still, as it were, only at the very threshold of the Great Creator's sublime works, the amazing profundity of which time itself will prove too short, and the most powerful human intellect too feeble, entirely to fathom.

Art. VIII. Observations on the Fishing Grounds and Fish of St. Margaret's Bay, N. S.,—*Continued.* By Rev. John Ambrose.

(Read March 4, 1867.)

In resuming my account of the Fishes of St. Margaret's Bay, I shall commence with the pollack. These fish—the full grown ones—strike into the Bay in June, and leave about the last of November. The young ones come much earlier. Their food is the same as that of the cod, but the most taking bait is something white and shining, such as a strip cut from the belly of the herring or mackerel. In the summer months they delight in the rough shoal water off the points or promontories where different currents meet. In such places a dexterous angler with strong salmon-gear and a whitish fly, may in the month of July kill many more fish in a given time, and enjoy very nearly as good sport, as among the salmon in our best streams. There is one of these "pollack-rips"—as they are called—within a mile of my residence, and in passing in my boat I often rest on my oars or lay-to to watch the gambols of those lively fish, as on all sides they leap out of water in pursuit of their insect prey. In rowing down through a narrow channel between Dover and Blind

Bay, on one occasion, I saw a middle-sized pollack chasing a whiting whose air-bladder was filled and could not be discharged, so that the poor fish—(as is often the case with this species in the month of September)—was obliged to skim along the surface with its head partially out of water. It made wonderful progress, however, in its endeavours to escape from its would-be murderer, but all in vain, for despite the shouting of my little boys who sympathised with the weaker party, the pollack at length made a vigorous jump at the fugitive, and all was over.

In all the coves and harbours around the lower parts of this Bay, where much garbage is thrown into the water, large numbers of young pollack are always to be found throughout the fishing season, varying from one to three or four pounds in weight. They are very voracious,—always ready for the bait thrown to them by the boys, and not at all squeamish at the sight of hook or line. Numbers of them are caught by the children and boiled for the pigs. These small pollack are famous scavengers, and with the help of the sea-fleas (a minute kind of shrimp) rid the coves of much offensive matter which would otherwise prove detrimental to the health of the fishermen. He who "openeth His hand and filleth all things living with plenteousness" is, as of old, careful that nothing be lost, providing at once for the health and sustenance of all His creatures.

There are "logy" fish among pollack, but as they are always full-grown and show no signs of organic disease, it may be presumed that old age is the cause of their sluggishness.

Pollack are caught here for the West India market, but—although very palatable when fresh and properly cooked—they are, like the spotted codling and haddock, very little used as food by our people. The mode of curing them adopted here is the same as that for cod, haddock, &c. They spawn in this Bay in October. The liver of the pollack is large and fat.

The lordly halibut next claims our attention, though he can scarcely be said any longer to belong to this Bay. Within the memory of our oldest fishermen, halibut were caught on the "gravelly ground" off the settlement of "sandy beaches," now called Bayswater,—as also off Peggy's Cove,—but for many years they have been but very rarely taken anywhere near the

mouth of the Bay. The "bank," thirty miles broad off Aspotogan, is now the ground where our people seek the halibut. Here—on clear, sandy bottom, in deep water, he lives and fattens by minding his own business and avoiding society; for except when the company of his species is a necessity, he is by no means gregarious in his habits. He feeds as well by night as by day, and haddock is his favourite food when he can get it. His interested friend, the fisherman, having discovered his weakness on this point, suspends the coveted tit-bit as near the bottom as possible, for like all flat fishes the halibut seeks the lowest levels.

There are logies among halibut, both old and young, but these are mostly wounded fish. The liver in this, as in all other sick fishes, shrinks and turns of a dark colour.

Halibut nine feet in length have been taken by our fishermen.

Whiting come into the Bay about the first of September, and are then in fine condition. Last year they were more plentiful than for a long time before, and came into the Bay in June. They are not very plenty here, and are becoming more scarce. No special endeavour is made to catch them, as our people have a prejudice against them, fancying them unfit for food. They mesh in the mackerel and herring nets,—sometimes as many as a dozen in a net. Mr. James S. Kizer caught one with a hook, when fishing for cod, as have also several others. As they are frequently cast back into the water when taken half-strangled out of the nets, this may account for the numbers of them which are seen skimming along on the top of the water, unable to descend to more agreeable depths.

As my design is to give our edible fishes the first place, I must now pass by a large class of interesting fishes of a larger size, and take up the king of our barrel-fish.

The Mackerel. This fish is caught, more or less, in all the harbours and coves in and around the Bay,—*i. e.*, when it is caught at all, for of late years mackerel fishing here has proved very disastrous to all connected with it. In days gone by, fortunes were rapidly made by the seining of these fish, and our people, especially those of French descent, can scarcely be persuaded to enter upon the more slow but sure net and line fisheries. Various reasons are alleged for the very irregular

and scanty visits of the mackerel to these, their old haunts. One is the practice of catching them with the hook until late in the autumn in the Gulf of St. Lawrence. There thousands of barrels of choice bait are daily thrown to the expectant schools of mackerel by the many crews of American and other fishermen, and thus like flocks or herds of shore animals, the immense schools of these fish are detained by choice and plentiful fare until very far beyond the old time in autumn, when their custom was to leave the Gulf of St. Lawrence and trim along these shores on their western course. When they do come now, their arrival is so late, that the frequent storms of autumn, in many cases, prevent the seining of them at the outer and more favourable stations. In support of this theory our fishermen affirm that in the year 1856, when H. M. S. *Styx* prevented the Americans from fishing in the Gulf of St. Lawrence, the mackerel ran out of the strait of Canseau and along these shores at their old season, a much earlier period than usual, trimmed the shores much closer, and were caught in far larger quantities and of a better quality than common, all owing to the earlier and therefore calmer season at which their visit to this Bay occurred. At all events, I am credibly informed that in that autumn mackerel were taken here with their mouths torn by the hook before the *Styx* interfered with their would-be captors.

The first run of mackerel strike in here about the 15th of May, and in one night will strike the shore for over a hundred miles in extent, where not one was seen the day before. From this fact some of our fishermen infer, that this first run comes in directly from sea, and not coast-wise from the westward. After striking the shore, they run eastwardly in immense schools, and for several days in calm weather the whole surface of the ocean outside of the mouth of the Bay, as far as the eye can reach, is blue with the "break" of them, running with the mouth open and partially out of water, in pursuit of "britt," a semi-transparent fish, about an inch long, with eyes very large in proportion to the size of its body, and thence called "eye-bait" by most of our fishermen. At this season those britt swim along the surface of the water. This first run of mackerel, which are No. 3's,

has of late years never struck in very plentifully, and in the needy time of spring, when with their winter stores spent, our fishermen with hungry eyes watch these swarming millions sweeping past their shores, I have often stood on the cliffs at Peggy's Cove and Dover and thought that some sort of net, with widely stretched arms and a net-work floor, might be moored off by our people in calm weather. Into this the fish might unwarily enter, like the wild animals of Africa, into a gradually contracting enclosure, where a dexterous manœuvre on the part of the watchers suddenly shuts them in. In consequence of running open-mouthed at this season, the fish will not mesh in a net.

The second run of mackerel strike in about the middle of June or first of July, still running eastwardly. They are No. 3's, and trim the shore when the wind is southerly. June and July are their spawning months, and it is not unlikely that their old spawning grounds are the smooth bottoms along these shores, whence, like the herring, they may have been driven by the sweeping of the seines. But as the wanderings of fish are largely influenced by the movements of food, and as the food of one sort seek for an entirely different food for themselves, it may be discovered that causes little suspected may in a remote but sure way influence the run of our sea fish. It may eventually appear that it is not the salmon, the cod, the hake, the haddock and the pollack alone that are suffering diminution, or are kept from their old haunts by the damming of our streams. It is not, in the end, profitable to disturb the arrangements of a beneficent and all-wise Providence.

The third run of mackerel takes place about the first of August. These have no spawn in them and are running westwardly. It is the opinion of many that these are not returning from the Gulf of St. Lawrence but from sea, and it may be that a portion of the immense schools passing eastwardly in spring strikes off to some favourite bank outside, to deposit the spawn. Or there may be a sort that never go as far east or west as the others, but winter along our shores, for mackerel have been brought up from the muddy bottoms of some of our outer coves by persons spearing for eels through holes in the ice. Or again,

as there are exceptions to all rules, and as there are many individuals among migratory birds which separate from the main flocks and remain here for the winter, so it may be with their cousins* the fishes. There is yet much to be learned by careful observation,—and a record of apparently trifling circumstances, such as is often found in the transactions of Natural History Societies, may in the end lead to discoveries of great value to commerce.

Many mackerel in August are found to have a strong coppery taste, and to produce symptoms of poisoning in those who eat them. Our fishermen attempt to account for this by the supposition, that somewhere off at sea the fish have been feeding on the sides of submarine hills containing copper ore. This reminds me of an anecdote in the London *Guardian* of January 17, 1866. "In the aquarium of the Liverpool Museum are several live soles. The bottom is covered with an abundance of the pretty little variously coloured pebbles found in the Isle of Wight, the forms and parti-colours of which those soles have so completely adopted, that when one is lying quite flat and still upon the surface, it is with the utmost difficulty the mere looker-on can distinguish the back of the creature from the strata on which he is reposing. He is, in fact, spotted all over with the colour and form of the pebbles." So far the *Guardian*. Cod and many other fish are also well known to be dark, light, or parti-coloured according to the deep, shoal, or rock and sand bottom to which they resort. It is not, therefore, altogether improbable that either from their situation or their food, mackerel at times obtain this peculiar coppery taste. They are at any time unwholesome for pigs if eaten raw, and in this they differ from the common sort of fish. Fishermen attribute this unwholesome quality when eaten raw to the blood of the fish.

The third run of mackerel are mostly No. 2 fat, with some No. 1's among them. They trim close to the shore when the wind is north-west or north, and sometimes run up as far as Mill Cove, thence running out along the west side of the Bay.

About the first of October the large, fat No. 1 mackerel begin to arrive, heading westwardly, coming from the Gulf of

* Gen. i. 20.

St. Lawrence. The first arrivals are generally but small detachments of the main body, which passes along from the first to the last of November. As the mode of capturing these fish is vividly described by Dr. Gilpin in the last year's Transactions of this Society, I need not dwell upon this part of the subject further than to remark, that attempts are very seldom made here to catch mackerel with the hook. When this system is tried it is only with No. 3 fish in June and July. The best bait is a piece of the belly of the mackerel, for these fish are terrible cannibals, and will in a moment tear to pieces and devour an unfortunate wounded companion. When in a seine for any length of time, all that mesh are eaten by the rest. Here also another peculiarity is observed. During and immediately after a heavy shower—unless frightened by thunder—the mackerel in a seine will rise to the surface to drink and bask in the fresh water, which, of course, for a little time, remains on top. For the same reason these fish sometimes "show" or break water better in rainy than in fine weather.

It is also observed by our fishermen, that in time of drought in the early part of the summer, mackerel trim the shore better than in a rainy season, and from this they infer that they are seeking the fresh water of the brooks and rivers.

The food of these fish is sea-fleas, young herring and alewives, britt, or eye-bait, &c. As young alewives are a favourite bait for them, the damming of our rivers, by which the propagation of these fishes is prevented, is no doubt one cause of the scarcity of mackerel in our bays of late years.

The possibility of making large hauls and speedy gains invests mackerel fishing with a charm, which like an ignis-fatuus leads many a fisherman to his ruin. Many have already left the Bay, deprived of house and home by their creditors; but others remain, encouraged by an occasional instance of great success, like that which a few years ago befel one of my parishioners. Year after year had this man been sinking deeper and deeper in debt, until one autumn his merchant in Halifax, wearied out, refused to credit him with winter supplies for his family. Bursting into tears, the poor man turned homewards to meet his needy and helpless wife and children, but on his

way called at Dover to superintend the storing of his fishing-gear for the winter. Casting his desponding eyes over the Cove in front of his stage, he was delighted to see a large school of mackerel entering the passage. An eager crew sprang into the seine-boat, and in a few minutes our poor fisherman found himself the owner of eight thousand dollars worth of prime No. 1's. In a few days he presented himself again to his merchant, again craved supplies, was again refused, and then suddenly changing his tone demanded his bill, paid the astonished merchant in full, and ordered and paid for a plentiful supply for the winter. One of the prettiest cottages in the parish is pretty much all that remains to him now of that famous haul, succeeded as it has been by many years of failure.

A very considerable proportion of the catch of mackerel is annually lost to the Province, by the very careless method of curing and packing too frequently followed on our shores. In the first place they are often left too long exposed to the sun and the air, before salting, and for this cause many barrels of Nova Scotia mackerel are every year condemned in foreign markets. Another evil is the insufficiency of the barrels used by too many fishermen. Two hundred pounds of No. 1. fish, worth from $12 to $15, and sometimes even $20, are too often packed into a barrel costing twenty-five or thirty cents, made of knotty and unseasoned stuff, and therefore dear even at that price. These barrels bear no rough handling, soon shrink and lose the pickle, the contents are spoiled, and the character of our fish is depreciated in comparison with those of other countries.

But time urges me on, and I must close with a few notes on the Herring.

Of these there are several varieties. The first run in the spring after the fishing commences, are called the "Bank herring." They are large and fat, and occasionally come in shore, but are generally caught on the banks and shoals off the coast, about the first of May. These are thought by some of our fishermen to be the sort called Labrador herring, as they come in large bodies from the westward, and are always at this season heading eastwardly, as if returning to their north-eastern home. They are full of "britt" or "eye-bait," and when the

wind sets in southerly, and drives these little bait-fish towards the shore, the herring always follow them. Several years sometimes pass by without a visit shorewards from these bank herring, but they are sometimes plenty, as many as twenty barrels being taken in a single night by a "fleet of nets,"—*i. e.*, two nets fastened together, and making a total length of forty fathoms, with a depth of one hundred and fifty meshes. The north wind causes these fish to seek bottom, and move off the coast. When shrimp are driven on shore by the winds and currents, these herring strike in in large schools. The tide and currents exercise a stronger influence over the shrimp bait than the wind. About the latter part of May, immense quantities of shrimps are sometimes driven ashore in our outer coves.

The next run comes in July, and consists of what are called "shore herring." They are of smaller size than the "bank herring," and are fat. This run heads westwardly. They trim the shore, and a west wind is the most favourable for their visits. In calm weather they generally keep to bottom, depositing their spawn on the smooth sand, but when the weather is rough, they run nearer the surface. By the first or middle of September, their spawning season is over, and the fish are poor. Scattering fish are found all through the year, with spawn in them. In November, about the last of the month, they leave the Bay for a time, but revisit it during the winter. Considerable numbers are taken in nets during winter, in coves with muddy bottoms. In the latter part of January, and throughout February of this year, herring were observed schooling in the bay, and grampuses in considerable numbers, gave sure evidence of the presence of their favourite food.

But in summer the dog-fish appears to be the principal disturber of the herring's designs. These voracious creatures are very gregarious, and are mostly found in a well-arranged host, either inside or outside of the school of herring. Fishermen say that the north wind is poison to a dog-fish. If, therefore, the dog-fish are between the herring and the shore, the north wind will cause both hosts to leave for deep water. And so, on the other hand, if the dog-fish be outside of their prey, a southerly wind will bring both in shore.

It will be unnecessary for me to say anything on the relative modes of dressing the herring, as practiced here where they are frequently spoiled, and in Holland, where the very superior mode of treatment gives them a delicious flavour. This has been fully explained by T. F. Knight, Esq., in his valuable pamphlet. One remark, however, I may venture with reference to the barrels in which our Nova Scotia herrings are too frequently packed. They are not only defective in material, but faulty in size, for many of them are too large, so that the fish working loose, become softened and spoil in long voyages to warm climates.

A good system of inspection of both fish and packages, is a great desideratum in this Province. A Chief Inspector, thoroughly competent to teach our fishermen the best and most improved systems of catching and curing fish, would prove a very valuable officer, if possessed of zeal and tact. His salary should be paid out of the public revenue, and not by the fishermen, who would also be expected to pay the deputy inspectors. I am very glad to see that Mr. Knight's pamphlet strongly recommends the encouragement of Fishing Societies by the Government, in the same way as Agricultural Societies, and for similar ends, viz.: the improvement of implements and modes of labour. By such wise and generous means as these shall a great branch of industry be fostered, which shall not only add vastly to the material wealth and naval importance of this country, but will impart a tinge of manliness, hardihood, and enterprise, which will ennoble its national character for all time.

Art. IX. The Geology of Gay's River Gold Field. By Rev. D. Honeyman, D. C. L., F. G. S.

(Read Dec. 3, 1866.)

This peculiarly interesting Gold Field is situate on either side of the old Gay's river road, and about four miles from Gay's river and Stewiacke river, or intermediate between those two rivers. Approaching it from the west, my attention was first specially attracted by an outcrop of lower carboniferous limestone, containing the fossils characteristic of this horizon. This occurs on the roadside. Advancing, I observed argillite strata

crossing the road in numerous outcrops, shewing that we had passed from the lower carboniferous into the horizon of our gold fields. At a short distance to the left of the road, gold diggings are observed.

Passing onward we still meet with outcrops of argillite, and other diggings appear nearer the road and on the same side of it, and then on the right side; and at a little distance from the road there is a brook with a saw-mill, where other diggings are to be seen. Farther on we still find an outcrop of argillite, and then we evidently pass again into the lower carboniferous, as I observed, about two miles distance from the last argillite outcrop, plaster pits on either side of the road, and succeeding these at some distance, an outcrop of sandstone. We have thus on this road a geological section, showing a lower silurian centre, succeeded on either side by lower carboniferous rocks. My attention was chiefly directed to the first of the diggings referred to. In the examination of these I received valuable aid from Mr. Gay, to whom I am indebted for much of the information which I am now to communicate. On examining the excavations made, I found an extension of the argillite, which I have referred to as outcropping on the road, unconformably overlaid by a thick stratum of conglomerate of undoubted lower carboniferous age, and the latter in turn overlaid by a thick accumulation of drift material. The argillite underlying the conglomerate exactly resembles the slates of many of our productive gold fields, being of a greenish hue and greasy touch. It is inclined at the usual high angle. The conglomerate reposes on the edges of argillite, appearing to dip slightly in a direction opposite to the dip of the former strata. This conglomerate is of variable coarseness, and a slight examination of its composition is sufficient to show that this locality was, so to speak, an "Ovens" in the lower carboniferous era,—that it was a beach on which the shingle of the period accumulated, derived from the argillites, quartzites, quartz, and granites of the lower silurian period,—that the shingle was cemented by the ferruginous constituents of the same rock, decomposed by the chemical action of the salts of this ancient sea. The conglomerate is composed of slate, quartzites, quartz, mica, felspar

(?) and oxide of iron and gold. The pieces of slate imbedded in this conglomerate are often large and angular; the quartzite and quartz sometimes occur in boulders; the mica is grey and glistening; the oxide of iron gives to the mass a rusty hue, which is now and then varied by the lustre of the precious metal.

In illustration of the cementing process to which I have already referred, I may observe that a modern example may be seen at Sydney Mines, Cape Breton. In 1861, when examining the section of carboniferous rocks on the shore, my attention was attracted to a conglomerate on the beach, at the mouth of a level belonging to one of the mines. The water flowing from this level is highly ferruginous; it flows into the gravel which is also washed by the sea, and a cementation of the gravel and sand is the result, and the conglomerate referred to is being formed. I would now direct attention to the position of the gold. It is found in the argillite, according to Mr. Gay's statement, and in the drift, and it is found in the conglomerate, as the specimens before us strikingly indicate. When it occurs in the argillite it is embedded in debris inserted in former openings of the strata in the line of strike, or at right angles to it; the debris in the latter being generally the more productive. Auriferous quartz leads have not yet been found in the slate, although there can be little doubt that the gold has been derived from such a source.

The gold found here is generally connected with the conglomerate. This conglomerate is said to be in some places about thirty feet in thickness, but while it is considered that gold may be found throughout the mass, it is found occurring chiefly at the bottom of the conglomerate, or where it rests on the argillite. This is easily accounted for: when the original gravel was washed by the sea, the superior density of the gold would cause it to settle at and towards the bottom. In specimen 1, the gold appears on the edges of the argillite upon which the conglomerate has rested. In 2, 3, it is on the smooth side of the conglomerate, which was originally in contact with the argillite; and in 4, it was also near the argillite. I was informed that gold is also found in the drift. This is not at all unlikely,

as this is mainly derived from the underlying and associated rocks.

The degree of richness of the conglomerate described is likely soon to be thoroughly tested, as a crushing mill, in course of erection in the locality, is expected soon to be in operation.

These observations conclusively show that the great upheaval of the granite, quartzite, argillite and auriferous quartz, was an event prior to the formation of even the lowest member of our carboniferous system. This fact is established by the evidence of composition of the lower carboniferous conglomerate, and its unconformability with the underlying argillite. Now the geological age of the former is established by the fossiliferous limestone of the section. What, may be asked, is the geological age of the argillite? Does it belong to the age immediately preceding the lower carboniferous, or is there here a break in succession? We are accustomed ever since Dr. Dawson wrote his classical work, *Acadia Geology*, to style the argillite in question, and its associate quartzite, as lower silurian. Is this incontrovertibly the age of these sedimentary strata? Comparative lithology has hitherto been the only method of determination available, and Dr. Dawson has certainly very ingeniously applied the method. On examining Prof. Ramsay's admirable catalogue of the rocks of Great Britain, in the Museum of Practical Geology, Jermyn St., London, and comparing our own with the descriptions there given, I have for some time arrived at the conclusion that as far as mineral structure is concerned, our rocks in question, may either be devonian or lower silurian. If, however, Prof. Jukes has succeeded in his recent attempt to demonstrate that the so called devonian rocks of England, which have given the term to geology, are after all silurian, Dr. Dawson's comparison may be considered as legitimate and conclusive. I would adduce another argument in confirmation of the opinion that the formation in question is lower silurian. Being persuaded of the correctness of the opinion expressed, I took occasion in the month of February, 1861, when advocating the establishment of a geological survey of the Province, before a Committee of the House of Assembly, to quote from Murchison's *Siluria*, the confidently expressed opinion, that the metamorphic lower

silurian was the formation in which gold was chiefly found in workable quantities—assuming that this was the geological character of the Nova Scotia rocks under consideration. I argued from the discovery of gold at Tangier, that a proper examination might prove these rocks to be extensively auriferous. The discovery of gold the second time at another locality in Tangier; the numerous discoveries made in rapid succession of auriferous deposits in other localities; and the productiveness of these gold fields, shew that the inference was a legitimate one. These results corresponding so strikingly with Sir Roderick Murchison's observations, may therefore be adopted as a *vice versa* argument in establishing the age of the geological formation in question.

The aid of palæontology is much desiderated for the purpose of a conclusive decision of the question. A few years ago I met with a piece of dark shale containing a reticulated organism, which, at the time, I considered as derived from the dark slates which had been quarried in the region. I submitted the specimen to a distinguished naturalist, Prof. Wyville Thomson, of Belfast, and it was considered to be a leaf, imbedded in black carboniferous shale. As the specimen was not found *in situ*, I am persuaded that this opinion is correct.

Another desideratum is regularity of succession. After a lengthened and extensive investigation, I have not found these rocks overlaid conformably with rocks of a more recent period. When in contact, or nearly so, it is invariably with carboniferous strata unconformable in position,—yet another is relative *inter*-position. I give an example in explanation. It is an example already referred to in my paper on the Geology of Antigonish County. In Lochaber we find devonian strata, metalliferous, &c., to a certain extent metamorphic, owing to the influence of trap-eruption. As far as I have yet examined them, they are destitute of fossils, and isolated would be of doubtful age. These rocks, however, are found perfectly conformable, with strata containing organisms equivalent to D of Arisaig, *i. e.*, equivalent to the Lower Helderberg, United States, or to the Upper Ludlow of England, and also they are succeeded by lower carboniferous sandstone and limestene. I therefore con-

sider that I am warranted in assigning to these strata a devonian age. Our auriferous quartzites and argillites over-lie the granite of uncertain age, and, as I have already observed in the Gay's River Gold Field, the argillite is overlaid unconformably with the lower carboniferous conglomerate. So that the age of argillite, &c., cannot be determined by interposition.

The stratified rocks of our gold fields have marked peculiarities, by which they are easily distinguishable from the stratified rocks of the interior of whatever age; and no one can hesitate on leaving the one and entering upon the other—in maintaining that the formations are altogether different. I have already at considerable length, directed attention to these formations as they exist in Antigonish county, and I consider that an insertion of the Arisaig silurian series and the Lochaber division is sufficient to fill up the breach in succession between the lower silurian argillite and the lower carboniferous conglomerate.

Art. X. The Coal Trade of the New Dominion. By R. G. Haliburton, F. S. A., F. R. S. N. A. *Secretary of the Nova Scotia Coal-Owners' Association.*

On glancing at the map of the world, the eye rests on three points as peculiarly adapted to be the great centres of commercial and maritime activity. The first is situated on the eastern, and the second on the western shores of the Atlantic, and the third is to be found on the Pacific coast of America. All of them lying sufficiently far from the tropics to be the homes of a healthy and industrious race, form portions of the British Empire. England, placed between the German ocean and the Atlantic, seems to guard the highway of commerce from the North of Europe with the rest of the world. Nova Scotia, standing far out into the ocean, looks like some vast pier which nature has raised up to intercept the trade of the New and of the Old World, while Vancouver's Island more nearly recalls to us, by its climate and its insular position, the geographical features of the mother country. Yet valuable as a favourable position is to enable a country to lead the van of commerce, there are other scarcely less important elements of national

greatness. A people possessing abundance of coal and iron must in time become a capitalist among nations; but combine geographical advantages such as I have described with the possession of these essential elements of national wealth, and you constitute a country whose greatness is simply a question of time, and is inevitable.

All of these peculiar advantages we find combined in Great Britain and in Nova Scotia and Vancouver's Island.* Along the shores of the Atlantic, from the Orkneys to the Cape of Good Hope, there is only one country, Great Britain, which possesses extensive coal fields that are adjacent to the seaboard. Spain has a large carboniferous tract, but it is undeveloped, and its capabilities are still unknown. On the western shores of the Atlantic, from Cape North to Cape Horn, the only accessible coal fields of any importance are those of Nova Scotia; while on the Pacific coast, from Behring Straits to the Straits of Magellan, there is nothing to compete with Vancouver's Island, which, with its coal seams cropping out on the shores of excellent harbours, is destined to be the future coal depot for the steam fleets of the Atlantic, and the home of manufactures and commerce. That the eastern and western portals of British America should be so favoured by nature, augurs well for the New Dominion, which possessing a vast tract of magnificent agricultural country between these extreme limits, only requires an energetic, self-reliant people, worthy of such a home, to raise it to a high position among nations. Nova Scotia and Vancouver's Island, however, find to their cost that these advantages, great as they are, require the aid of capital and labour, while Great Britain has discovered to her dismay that her coal fields, like all things earthly, must have an end, and are liable to exhaustion. The theory advanced with great ability by Mr. Jevons in his well known work on the coal question, that within a century this truth will be sensibly felt by Great Britain, has excited much interest and no little alarm. Mr. Hull, a previous writer, remarks:—"I can conceive the coal fields of this country so far exhausted that the daughter in her maturity shall be

*I am not aware whether iron mines exist in Vancouver's Island, but we may infer that this is the case, judging by the other coal fields of North America.

able to pay back to her mother more than she herself received. May we not look forward to a time when those 'water lanes' which both dissever and unite the old and new world, shall be trod by keels laden with the coal produce of America for the ports of Britain ?" By the term exhaustion is meant, not the working out of all the coal in Britain, but of that portion which is at such a moderate depth that it can be worked profitably and can compete with the product of foreign coal fields. The *Quarterly Journal of Science* for October, 1866, has an interesting article on the subject, which while opposing Mr. Jevons' theory to a certain extent, admits that the price of British coal must, before many years elapse, increase to such an amount as to render the exportation of coal for ballast no longer practicable, and to transfer the smelting of iron and the heavier branches of iron manufacture to foreign countries; and it points to Pennsylvania as the future inheritor of the present profitable branches of industry connected with the coal fields of Great Britain. It supposes that the lighter and more elaborate manufactures requiring little fuel will engross her industrial energies, and supply the loss that the supposed advantages enjoyed by American coal and iron will entail on her. A map of the coal fields of the world, that accompanies the article in question* suggests some important views as to the future of Nova Scotia, and may lead us to hope that the mantle of British industrial wealth connected with the use of cheap iron and coal will descend, not upon our American cousins, but upon Nova Scotia. In point of position her mines compare favourably with those of Britain. The Belgian and French coal fields are not very far removed from the sea coast, and might, if not exhausted as soon as those of Britain, compete with her collieries at some future day when the price of British coal increases as has been anticipated. But Nova Scotia need fear no competition on this side of the Atlantic. No ingenuity can overcome the difficulty of a long land transport. Railways are expensive luxuries. The freight over every mile of railway represents so much outlay actually lost to the nation—so much deducted from the value of its products. The manufactures of

*The map accompanying this paper is, with some slight additions, copied from portions of the map in question.

New England are dependent for their existence on obtaining cheap coal, either from England or Nova Scotia. The former is a supply contingent on the other branches of trade, for English coal unless sent as ballast could not possibly compete with Nova Scotian coal on the Atlantic seaboard. The imposition of a heavy duty on imported coal is as clearly fatal to manufactures in Massachusetts as draining the life blood is fatal to vitality. This might not be so if there were no coal mines in the interior; but with the vast coal and iron regions of Pennsylvania to invite manufacturers to their vicinity, it is clear that every cent paid by the New England manufacturer for railway freight on his coal brought from Pennsylvania is a tax on his industry and a protection to the Pennsylvania manufacturer. But if the heavy freight on coal from Pennsylvania prevents its coming into competition with Nova Scotian coal on the sea board, unless protected by a prohibitory tariff, if the Americans cannot place their coal on the wharves at Boston and New York as cheaply as we can, it is manifest that American coal can never fulfil one of the main ends to which the export of coal has so eminently conduced in Great Britain. Mr. Jevons has shown in his very interesting and valuable work that the commerce of England is immensely benefited by one branch, and that the smallest department of the coal trade—the export as ballast to foreign countries. By this means the outward voyage, if it brings no profit, though this it often does, is not a dead loss to the shipper, to be made up by increased freight of the raw materials brought back on the return voyage, and by the enhanced cost of the article imported to be paid by the manufacturer, and ultimately by the consumer.

If Nova Scotia were part of the United States, the manufacfactures of Massachusetts would be compelled to emigrate to this province, for it would be impossible for them to compete with the productions of Nova Scotian industry, protected as they would be by that tariff which no legislature can repeal, which nature itself has favoured us with, and which consists in having our coal and iron near good harbours, and in our possessing what tradesmen so well appreciate the value of, "a good stand for business." If the day should ever come when the two

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NORTH AMERICA
UNITED STATES
NEW DOMINION
Newfoundland
Nova Scotia
Quebec
St. Johns
Bermuda I.
St Thomas
SOUTH AMERICA
Brazil
EUROPE
Ireland
Great Britain
ASIA
AFRICA
MAP OF THE COAL FIELDS OF EUROPE & AMERICA.
C. & A. CLARKE, LITH'S Halifax N.S.
REFERENCE.
1. England & Wales
2. Scotland
3. Ireland
4. France & Belgium
5. Saarbruck, Prussia
6. Hanover & Waphalia
7. Bohemia & Silesia
8. Poland
9. Turkey
10. Spain & Portugal
11. East & West Russia
12. Central Russia
13. Southern . . . Denetz
14. Brit. Pos. N. America
15. United States
16. Vancouver Isl.
17. Brazil
18. Africa
Extension of Coal Deposits
Lignite
Routes of Steamers

great families of the Anglo-Saxon race in the New World should find it to their interest to abolish the formidable barriers of hostile tariffs which are growing up between them, to level the frowning fortifications which scowl defiance at each other, and which even in peace give us a "lively sense of benefits to come" in the shape of towns burned down, commerce paralyzed and valuable lives destroyed, the most prosperous portion of the republic, and of the new world will be that which combines everything to make it the entrepot of trade and commerce. That day is farther distant than philanthropists might hope. The heavy taxes in the United States, the violent party storms that threaten to uproot what even the whirlwind of civil war has left standing, Fenian raids, and the incessant abuse of England, put off the day when our ministers of war will be useless luxuries, and when a union of North America under one government will be hoped for, or desirable. Although such a union would in six years quadruple the value of mineral property in this province, at present it would be a ruinous or at best a hazardous experiment. It will take years before peace can efface from the sword the stains of a bloody contest, and we are not likely to wish to tread upon the ashes that conceal the burning embers of civil war. Let us then look at what is practicable, not at what may be a question for our children and for posterity.

Within the past year the map of the world has been altered to admit a new Dominion among the nations, and a large portion of the continent has changed its name, if not its destinies. We cannot shut our eyes to the fact that its position is, to say the least, inconvenient. The Americans through accident and our bungling diplomacy seem, at first glance, to have monopolized all except the outskirts of the cultivable portions of the continent, and to have left us not much more than the selvage of an empire, and the casual observer might infer that England having long ago entailed the bulk of her possessions in America upon her first born, could only spare us the limited allowance of a younger son. Scant and attenuated as it may seem, however, when compared with the compactness and immensity of the United States, it is vast enough to be the home of a great people, if they are only united by national feeling, and by the bonds of

commerce and trade. Neither of these yet exist, nor is it easy to create them suddenly in the face of geographical barriers. True it is that we might imitate our neighbours and "make history," by having some of our towns burned by an enemy and our people cut off on the battle-field, and our minister of war might in time become a famous personage; but it is far better with our small population, that we should reap oats rather than glory, and it is probable that, until we have a surplus population, our people can be more profitably employed in cultivating than in fertilizing the soil. Our bond of union, then, must depend on a community of interests, on an interchange of commodities between the East and West. How is this to be attained? We must not shut our eyes to the fact that our commercial system must be adapted to the geographical difficulties of the Dominion. Nature would seem to have intended Ontario to trade with New York, Ohio and Vermont, and has placed Nova Scotia and New Brunswick at the doors of Massachusetts, that intercourse might spring up between us. But the natural course of events has been retarded by artificial obstructions. A hostile tariff cuts off the eastern part of the Dominion from the natural outlet for its productions, and the question arises whether this very policy on the part of our neighbours may not be turned to good account in a national point of view, and be made the means of building up an intercolonial trade, and of uniting these provinces by common interests.

When the repeal of the reciprocity treaty was notified to our Government, Mr. Buchanan, in an able pamphlet, showed that immediate steps must be taken to open up the Lower Provinces as a home market for the flour of Western Canada, for even a limited mart near at hand is far more profitable than a more distant one however extensive, and he gave some curious statistics to show how, previous to the treaty, a barrel of flour was worth one-fifth more on the American, than on the Canadian side of Niagara. The American had his home market to fall back on, as well as his foreign market; whereas the Canadian wheat grower, having only a distant market open to him, found his wheat depreciated in value. With these facts Mr. Buchanan argued, that unless this home market could be

added to the foreign market for flour, the Canadian grain growers would be "*starved into annexation.*" He says :—

"To me it seems self-evident that now we must either be drifted by industrial necessity into Annexation, even in the absence of any disloyalty in these provinces, or must find markets for our industry, and an outlet for our trade through means of an intimate and indissoluble union of all the provinces comprising British North America.

"I believe, let me repeat, that the Provinces of British America have within them the elements of independent greatness and prosperity, but that these can only be reduced from chaos by a certain most energetic policy immediately gone into, in respect to our Provincial industry. Such a policy, I believe, would have the effect of saving to British America the advantages of the continuance of the Reciprocity Treaty with the United States, in the only way this can be done, viz :—by rendering us independent of it. Such a policy would at all events save these North American Provinces to Britain; while, without a homely and patriotic policy, the loss of them to the Empire will be more than likely, especially if the Reciprocity Treaty with the United States is withdrawn. My great object, therefore, is to impress others with my own strong convictions that *it is Vital that the Canadian Farmer should immediately have in the Markets of the Maritime Provinces a substitute for the Markets we may lose in the United States; and that it is equally vital that the Maritime Provinces should immediately have in the Canadas a substitute for the Trade they are now carrying on with the United States, under the Reciprocity Treaty.*"

A home market has been opened up in New Brunswick, and Nova Scotia, which imposed a duty on American flour, so as to create a trade with Ontario and Quebec. But the same ordeal, or rather a more serious one, is awaiting Nova Scotia as respects its staple product—*Coal;* for we have hitherto had no home market, and have had even our foreign market suddenly restricted. So far the pressure has been borne without a murmur; but this cannot last forever, nor is there any reason why it should. The Canadian wheat-grower's loyalty has been preserved by us from the test of starvation, and the time for "reciprocated duties" has arrived.

"Under no circumstances," says Mr. Buchanan, "can I anticipate any great disagreement of views among the parties who are to form the British American Confederacy. That they

have a common interest, will very soon come to be understood. And in the meantime I have no doubt that the other sections will join it with the same determination as Canadians do, to respect the views and experience of their new friends, a sentiment well expressed in the old lines:

> "Who seeks a friend must come disposed,
> T' exhibit, in full bloom disclosed,
> The graces and the beauties
> That form the character he seeks.
> For *'tis a union that bespeaks*
> *Reciprocated duties*"

While Nova Scotia, which shipped coal and fish to the United States and received flour in return, had every reason to hesitate in taxing American flour for the purpose of buying it from Canadians who wanted none of our productions, the people of Ontario and Quebec now stand in a very different position from what we then did. Our trade is theirs; our resources add to the general revenue. Every ton of coal sent back to the lakes is so much freight saved on the flour exported. Hence the grain grower, by a peculiar feature in the coal trade, consisting in its being the feeder and the complement of other branches of commerce, is jointly interested with the Nova Scotian coal owner in the return cargo of coal. Nor should the market be regarded as a limited one. Every barrel of flour used in the West Indies should come from western Canada to Nova Scotia, the Canadian ship returning from this province with a cargo of coal and West Indian produce, while the flour could be forwarded from Halifax with other articles to its destination, the Halifax merchant procuring West Indian produce in return. This is a natural and profitable channel of trade, which if developed and opened up, must become an important outlet for our respective staples.

Nor would the exports from Nova Scotia to the western portions of the Dominion be limited to coal. Salt and pottery, being bulky in their nature, in some British ports supply outward freights from England, and occupy the place which is generally assigned to coal. Salt works have been already commenced here with every prospect of success, and the existence in Pictou county (for my own personal experience of

the Nova Scotian coal fields is mainly confined to them) of superior clays for fire brick and pottery, immediately underlying workable seams of coal, point to a period when "the Black Country" of the New Dominion will centre in the neighbourhood of our coal mines, and the potteries of Staffordshire will find a colonial rival in Nova Scotia. The quality of the clays has been pronounced by parties in Staffordshire unsurpassed by anything that has been discovered in the mother country,* The enormous amount of coal used in the potteries of Staffordshire will give us some idea of the home consumption that may be created hereafter for our coal. But in addition to all these sources of demand for coal, we have our iron near excellent limestone within a few miles of the collieries now opened. What its quality is can be best judged by referring to Fairburn's eulogistic notice of it in his work on the manufacture of iron.

Along the northern and southern flanks of the Cobequid mountains, which seem to form the backbone of the country, we have immense deposits of hematite and specular ores. At East River a large bed of remarkably good hematite has been found, and on the line of railway I have discovered and tested a workable deposit of very rich specular ore, such as is imported at a large price into England from Sweden for certain purposes, for which very pure and refractory ores are required. Little doubt can exist that it would pay handsomely, if we were to compete with our Swedish rivals. The Acadia Charcoal Iron Works in Colchester county turn out an article equal to the best Swedish brands, but as they are far from the coal mines, they are unable to produce anything except the most expensive iron, for which the demand, even in England, is somewhat limited. But we may look forward to the day when the vicinity of cheap coal to abundant ore of excellent quality in Pictou county, will give rise to extensive iron works which will consume a large

*The *Eastern Chronicle* of New Glasgow shortly before the publication of the Transactions, made the following statement in a notice of the Crown Brick and Pottery works :—" There is abundance of suitable clay for the purposes on the spot, while the coal for burning purposes is within fifty yards of the kiln. There is also an extensive seam of fire clay alongside the coal pit, which has been pronounced to be of a very superior quality. We have been shown a small dish made from a quantity of the clay sent home to Britain, which takes a polish as fine as porcelain."

amount of our coal. What will be the growth of our coal trade in the next twenty years it is difficult to foresee. As respects the capabilities for supplying an extensive demand, Nova Scotian colleries now opened or in preparation, would raise in five years five or six millions of tons annually, and the supply could be gradually increased to meet any demand, however great.

That our coal trade will be very large, unless it is paralyzed by foreign legislation or domestic differences, is perfectly clear. In a few years not less than two millions of tons will be required for domestic purposes alone in British America, for even in the mild climate of Britain a ton per head is consumed for household purposes, and our long winters will render at least three times as much necessary. Every day "the wood age" is becoming a thing of the past, like the "stone age" of archæologists. Wood suitable for fuel gradually becomes more remote from roads and ports, and rises in price, so that even in Toronto coal is used for household purposes. In parts of the lower provinces the forests have been so wastefully and so effectually destroyed, that the farmers have to use coal for house purposes; and the scarcity of wood and the demand for coal are daily rapidly increasing. Mr. McCulloch estimated the yield of coal in Great Britain in 1840 to be thirty millions of tons; last year the consumption was *one hundred millions of tons.* As this progress has upset the calculations even of the most careful and experienced judges, how can we suppose that the future will not dwarf the present by the enormous development of manufacturing and commercial industry that is destined to take place. But the British American coal trade has elements of development which do not exist in Britain. We have the increase of population through immigration to count upon, and the increase of the domestic consumption of coal through our rapidly passing out of "the wood age." It will be a bold man who will venture to predict the limits of our coal trade in a few years, if it is encouraged in its infancy by wise legislation, and is developed by capital and industry. At present the mines of Nova Scotia are gradually passing into the hands of the Americans, there being more Nova Scotia coal stock owned in New

York and Boston than in the whole province of Nova Scotia. English capitalists will go to Mexico, South America, heaven only knows where, to risk their money in mines that, at the best, are but a lottery, while a province, the nearest part of America to England, with excellent harbours, a healthy climate, and unlimited mines of gold, coal, and iron, is left neglected, to become the property of American capitalists.

English capital, it is true, has found its way here, but the causes which led to this flattering result, are somewhat like those to which Prince Edward's Island is indebted for a solitary Irish emigrant having selected it as his home. He was shipwrecked on the Island, and never could earn money enough to enable him to leave it. The Duke of York having become deeply in debt to his jewellers, was saved from their importunities by the liberality of the British Government, which generously made them a present of our mines and minerals, the lease of which issued to the Duke, and was by him assigned to them. Our 'black diamonds' proved, however, a somewhat puzzling windfall to his Grace's jewellers, who sold them to the General Mining Association of London, an enterprising and wealthy English Company which had sunk a large amount of capital in foreign mines. The striking fact that the Nova Scotian mines, in spite of the heavy outlay necessary to develope them, and of the funds that were sunk in foreign mines, have at least quadrupled the value of the Association's shares, is a sufficient proof of the importance of these vast mineral resources which the British Government so recklessly threw away on a spendthrift and his favourites. This monopoly, which was partially restricted by an act of the Legislature, expires in 1886, when every trace of its exclusive rights will no doubt be swept away for ever. In the meantime large tracts are tied up by the lease. That so large an amount of valuable mineral property is now held by other companies, is due, not to the generosity of the General Mining Association, but to their fortunate ignorance of the extent of the resources which they had so long monopolized. The extensive areas reserved at Sydney, Lingan, Bridgeport, the Albion Mines, Springhill, and the Joggins, were supposed by them to include all the mines

that were worth having. Since then new carboniferous districts have been discovered in Cape Breton and in Nova Scotia, while in Pictou a far more valuable coal field than that reserved by the Association, has been found near Middle River. These new mines have been explored and are being opened up by foreigners, for though there is abundance of capital here, there is a slight want of enterprise among us. If, however, mining rights are only carefully preserved from being endangered by changes of Government, and by the claims of political partizans, we may rely upon strangers for the speedy development of our mines. In a material point of view it may matter little from whence capital comes, so long as our mines are opened up. But as the Americans are daily becoming the owners of our gold and coal mines, the political effect must in time be apparent. If we are to form part of the British Empire, it is desirable that we should be connected with it by something more than hereditary ties, and the grateful reminiscences of history. If the most important sources of provincial wealth are owned and developed by foreigners, the people must in time learn to look up with a filial feeling to those, whoever they may be, to whom they are indebted for the welfare and prosperity of the province. Fortunately, however, the capitalists of Ontario and Quebec are slowly turning their attention to our mines, and we may look forward to the day when, within the Dominion, we shall find the enterprise and the capital which alone are required. A future of manufacturing and mineral wealth is simply a question of time, and must necessarily result from the position and resources of Nova Scotia.

Of all the numerous Colonies of Britain, Nova Scotia, the oldest, the nearest, and the most neglected, presents the strongest family likeness to its mother country, in the singular variety and excellence of its resources, combined with its being near the markets of the world. A province, which ranks as one of the first fruit growing countries in the world, which has such a genial climate* that its grapes grown in the open air can rival

* No country can hope to be a centre of manufacturing or commercial activity, which possesses a rigorous or unhealthy climate. The following extracts may serve to remove some wide-spread prejudices as to the climate of Nova Scotia. The *Gardener's Chronicle* says, "Our readers and the visitors to the Fruit Shows of the Royal Horticul-

those of Italy, which possesses iron equal to that of Sweden, and gold which excels that of Australia and California in purity, which has unequalled fisheries, safe harbours, extensive coal fields near the water's edge, and above all a position almost midway on the very highway of nations between the Old and the New World, may hope, at some future day, to inherit a full share of that greatness, which Britain must, in her old age, resign to her children or to strangers.

Art. XI. Explorations in the Pictou Coal Field. By R. G. Haliburton, F. S. A., F. R. S. N. A.

From the discovery by Mr. French, in 1865, of the Albion Mines main seam several miles further west than it was supposed to exist, I was led to take up extensive mining rights in the vicinity of the Pictou Coal Mines. Mr. French, to whom this province is under great obligations, had proved that comparatively little was known of the extent of the productive measures, and that similar discoveries must soon be made in other directions. The explorations, which are the subject of this paper, were personally superintended by myself, and were conducted by the aid of a mining engineer on the following properties:—No. 1., situated on the south western side of the coal basin, on an area known as "the Culton property," and adjoining the colliery of the Intercolonial Company; No. 2, on the south eastern extremity of the basin, on the west flank of McLennan's Mountain. No. 3, at the eastern end of the basin near the waters of Merigomish, on a property called the St. Lawrence area. No. 4, on a property on the northern side of the basin purchased from Messrs. McDonald, McKay and

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tural Society cannot have forgotten the surpassing beauty and equal excellence of the apples communicated by the great Colony of Nova Scotia. *Certainly nothing like them had been previously seen at any Public Exhibition in this country.*" "What gives this collection especial interest is the example it affords of the excellence of the climate of a Colony which half the world believes to be dismally dreary." The *London Times* also says, "The beauty of the apple beats anything we have ever seen;" and the Royal Horticultural Society, in its proceedings, states, "The only other country except Turin, which exhibited grapes grown in the open air, was Nova Scotia, and several of these were of the same kinds as those from Lombardy, but *they seemed to have agreed better with this new habitat on the other side of the Atlantic, and to have beaten their old country cousins both in size and flavour.*" The explanation for this may be found in the fact that Nova Scotia is situated in the same latitude as Nice, and that its autumns are prolonged by its proximity to the Gulf stream.

Known, on the East River colliery. No. 5, on an adjoining property, purchased from Messrs. Beal and How, and now belonging to the Montreal and Pictou Coal Company. These explorations, therefore, are the most extensive that have hitherto been conducted in that county, and though undertaken for the practical purpose of discovering and developing coal mines, have incidentally thrown some light on the Pictou coal field, which may be interesting to geologists and to the public. I shall first select those explorations on the northern side of the basin, on the East River and Montreal and Pictou properties, as they are in the immediate vicinity of New Glasgow, and in a district which had been previously fully described and somewhat misunderstood.

Dr. Dawson, whose investigations have thrown so much light on the structure and formation of coal, and whose geological labours have reflected so much credit on his native province, has been for many years almost the only authority on the Pictou coal field, and his inferences were based on the limited information that was derived from the works of the General Mining Association, which were confined to the southern crop of the basin. Mr. Richard Smith, a former superintendent of that colliery, suspected, as I am informed, that there was a coal basin between New Glasgow and the Albion Mines pits, but this impression seemed to have been lost sight of, and the conclusion was, many years ago, somewhat hastily arrived at, that New Glasgow was situated on the southern rise of the basin, and that the coal which was supposed to be at an immense depth, was thrown down by a great down throw fault; the large seams not re-appearing to the northward. It was evidently assumed that the town of Pictou was situated on the northern rise of the basin, which would make it from ten to fifteen miles in breadth. Dr. Dawson, in his examination before the Mines' Committee of the House of Assembly, states as follows:—

"The outcrop of this bed is four miles in length. It is broken by a fault at New Glasgow where *it falls down several thousand feet.* It has not been found again in the county of Pictou. The other outcrop is about a mile to the S. E. of the mines.

"At New Glasgow the *coal is half a mile deep at least below the surface.*"—*Journ. H. A., 1845, App. 49.*

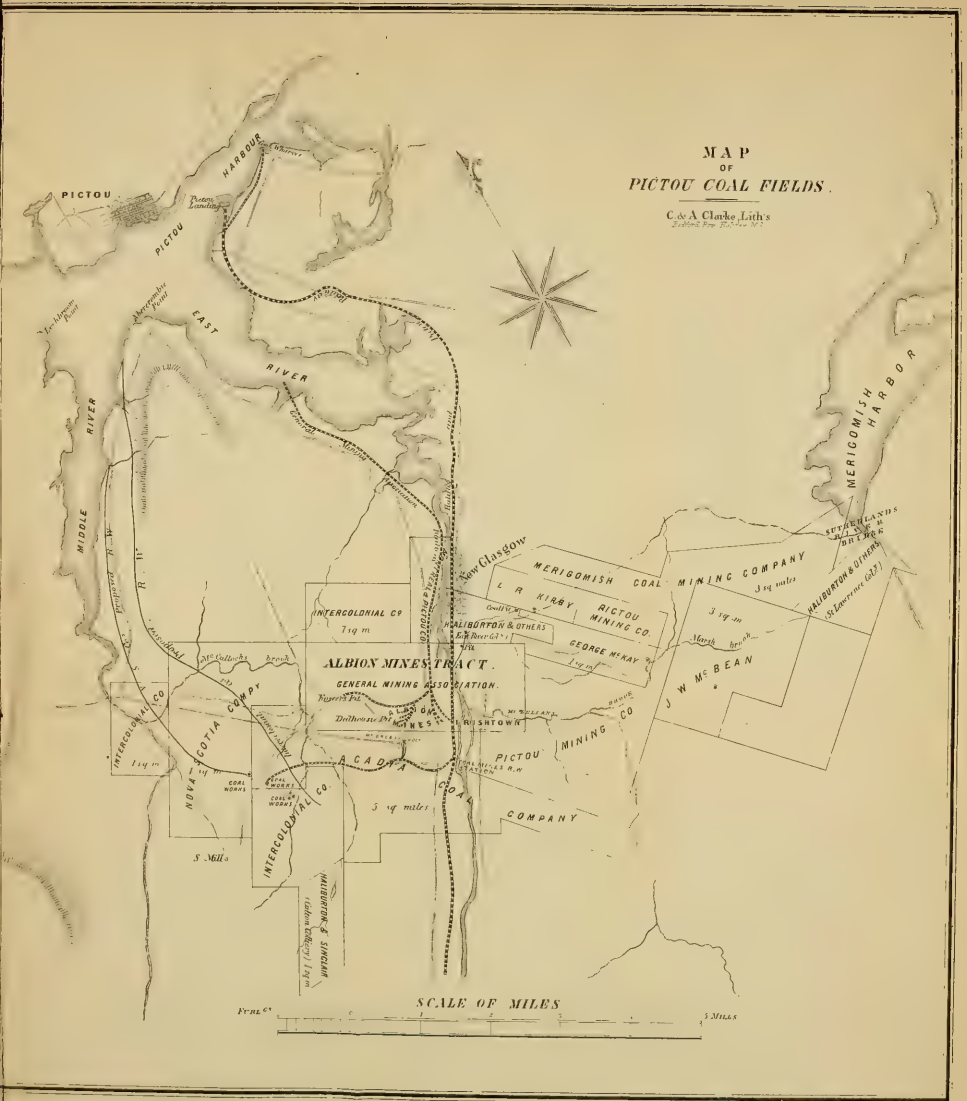
This view, as to the immense depth of the seams at New Glasgow, was adopted by the General Mining Association and by the public generally, and all the explorations at New Glasgow were considered as useless. In his Acadian Geology Dr. Dawson still partially adhered to his previous views, though he was evidently somewhat doubtful on the subject, which is evident from the vagueness of his language. The southerly dip near New Glasgow, which he had supposed was caused by a downthrow fault, he still attributes to a line of disturbance, and he speaks of the coal being "cut off" by a fault. Explorers and miners have been a good deal puzzled to ascertain whether he meant an "upthrow" or a "downthrow fault," as he does not state which it is, but the extract from his previous statement before the Mines' Committee shows what his views on this point were. Assuming them to be correct, the thickness of the Pictou coal measures would be immense, as we should have a succession of coal measures overlying the Albion Mines seams, dipping at a heavy angle northerly for several miles until we reach the northern rise as we approach the town of Pictou.

In the section given by Dr. Dawson (p. 244) he commences with the limestones and gypsums of Springville and the lower carboniferous strata overlying, proceeding, in ascending order, until he comes to the Albion Mines seams dipping nearly due north. He here reaches the southern crop or basset edge of the Pictou coal basin. He adds in his description of these measures, "the main seam has been very extensively worked, and its outcrop has been traced for several miles; but it is remarkable that it preserves its character as a good seam only for a limited distance. Both in the north-west and south-east extension it becomes very impure and intermixed with slate, indicating that though great in thickness it is very limited in horizontal extent. The measures also *are cut off to the northward by a line of disturbance* running along the south side of an enormous bed of conglomerate which *succeeds these rocks in ascending order*, or" he prudently adds with probably some misgiving, "apparently so."

His section is consistent with his previous statement before the Mines Committee, that the coal seams are half a mile deep at New Glasgow; and there can be no doubt that if they become still deeper beyond New Glasgow through a downthrow fault, the conglomerate must not only overlie them half a mile, but even more, according to the extent of the supposed downthrow fault, which he assumes runs along its southern edge. Practical explorations have entirely disproved this assumption, and have established that the Pictou coal measures are not more than one third as thick as Dr. Dawson infers, and that a pit twelve hundred feet deep would reach the lower seams in the very centre of the basin. They have also proved that the so called Pictou coal basin really constitutes two distinct basins, the one, which I may call the southern or Albion basin, lying to the southward, and the other to the northward of the conglomerate which underlies the productive measures. It is manifest that if the conglomerate were an upheaval since the coal was formed, we should have the Albion Mines recurring to the northward unless they had been affected by subsequent denudation. But so far we have no equivalents of the southern coal measures in the northern basin, and must assume that they were always distinct basins, and now differ, from their measures having been formed under different circumstances.

In October 1865 operations were commenced on the East River colliery, which was purchased for the purpose of working some upper seams of excellent quality which had already been tested. Finding while I was proving a small seam known as "the Richardson seam," near New Glasgow, that it dipped almost the reverse way to those of the Albion Mines, and that its underlying strata rested on the conglomerate, and that the conglomerate itself near New Glasgow dipped to the southward, and various dips on the west side of East River having indicated that the coal measures must come to the surface or crop near New Glasgow, I prepared the plan now exhibited, showing the supposed course of the northern crop of the main seam at the town of New Glasgow, and also on the west side of the river. We felt so assured of the fact that the Albion seams, instead of being half a mile deep at New Glasgow, must come to the

MAP
OF
PICTOU COAL FIELDS.


MAP
OF
PICTOU COAL FIELDS.
C. & A. Clarke Lith's
PICTOU
HARBOUR
PICTOU
EAST
RIVER
MIDDLE
RIVER
R. W.
MERIGOMISH
HARBOR
New Glasgow
MERIGOMISH COAL MINING COMPANY
3 sq. m.
L. R. KIRBY
PICTOU
MINING CO.
HALIBURTON & OTHERS
GEORGE McKAY
J. W. McBEAN
HALIBURTON & OTHERS
INTERCOLONIAL Co
7 sq m
ALBION MINES TRACT.
GENERAL MINING ASSOCIATION.
Dalhousie Pit
ALBION MINES
RISHTOWN
McLELLAN
INTERCOLONIAL CO
NOVA SCOTIA COMPY
1 sq m
COAL WORKS
INTERCOLONIAL CO
3 sq miles
ACADIA COAL COMPANY
PICTOU MINING CO
S. Mills
HALIBURTON & SINCLAIR
SCALE OF MILES
FURL.GS
5 MILES

surface, that we purchased the bed of the river and the property to the westward, and commenced explorations on the supposed line of crop. The first trial pit on the edge of the river was successful, as it struck the crop of the main seam, which was found lying at a heavy angle. Following the course indicated by the plan, we sunk a trial pit nearly half a mile to the south-westward, where we again struck the same outcrop. A working shaft was then sunk, and the results are thus described in the official report of the government Inspector of Mines :—

"A company has been formed with the title of the Montreal and Pictou Company, to work the seam which has recently been opened by R. G. Haliburton, Esq., on the west side of East river, and adjoining the Albion mines on the north. A shaft has been sunk through several beds of coal, varying in thickness from 2′.6″ to 15′.6″, and separated by beds of fire clay from 7 to 10 feet thick. They dip to the south-east at an angle 65°. Although these beds are so far apart as to be practically distinct seams, there are points of resemblance and other circumstances, which lead to the belief that they represent the main seam of the Albion mines, and that this colliery is on the northern crop of that seam. The shaft has been sunk 180 feet, and drifting commenced at a depth of 165 feet.*

"The discovery of coal on this area has added to the importance of the Pictou coal field in a remarkable degree. It has given to it a conformation which appears to have been entirely unsuspected, and by which a large quantity of coal is placed within easy reach. The same seam has been discovered by Mr. Kirby on the east side of East river, and to the north-east of New Glasgow. This extension of the knowledge of this portion of the coal field will doubtless lead to further explorations, the progress of which will be watched with interest."

Culton Area.—Explorations were commenced on this property in 1865, with a view to discovering the Campbell seam, which had beem identified by Mr. Poole with the Culton seam found on this property, and worked by Mr. Culton. The adit driven by him is situated on Bear brook, about a mile and a quarter from the Provincial railway. Explorations were com-

*Since the publication of this report a level has been driven 100 yards to the westward on the upper bench, which has increased to 25 ft. from roof to floor. The partings have apparently been only local, and caused by a bend in the strata, and have given out, leaving the seam without any partings. On the northern side of the basin therefore, the main seam more nearly resembles the same seam at Middle river, than at the Albion Mines. The coal was found to improve rapidly in quality to the west, and the measures to be undisturbed in our west level.

menced from a point near the centre of the Intercolonial company's property, known as the Campbell area—and not less than sixty bore holes and trial pits were sunk. A small overlying seam was discovered with a strike S. 12° W. It lay at a heavy angle, indicating either that the measures turn there rapidly to the west, or that there are traces there of the series of downthrows to the south-west, which the Acadia company found on the Fraser area, as they approached the eastern boundaries of the Carmichael and Campbell areas, our pit on the small seam being in the line of disturbance which the direction of those downthrows would take. From this point a series of bore holes and trial pits were sunk to the Culton pit, over nearly three quarters of a mile of country, and wherever the strata were reached, we found the same metals, which consisted of shales. The surface drift, which was very deep, contained particles of coal. The search was unsuccessful, as the explorations were evidently in the centre of the basin.

The Albion mines shales are a distinguishing feature of the Basin. Their enormous thickness is without a parallel, and as they overlie the large seams, they are a sure indication that the crops of the seams must be sought 'to the rise.' These shales serve to identify the Campbell or Culton seams with 'the main seam' of the Albion mines. To the south-west of the Culton pit the measures were found to assume a north-westerly dip, while near Oliver's mill, a mile farther west, the measures were found to dip in the reverse way, showing that the coal basin must sweep off in that direction and between the two points in question. More than a mile to the south of the Campbell area coal and fire-clays have been found by us, while the existence of the light sandstones of the Pictou coal fields still farther south, established the fact that the coal basin must turn in that direction. For two seasons this property has been explored by us, and as we are the only persons by whom it has been examined, the results of our explorations will have more weight than theories, however ingenious, by others who have never examined the locality. The extension of the coal field in this direction is most important, not only from the very superior quality of the coal, but also because it is found at so short a distance from the

provincial railway. A level was driven by us a short distance on this seam, which was found to lie at an easy angle, the measures on this area being flatter than in any other part of the Pictou basin, excepting where the upper seams occur, which generally lie at a slight angle, and are consequently as to their angle of dip and their out-crop, unconformable with the larger and lower seams. The seam, when followed in from the out-crop, increased, in a few yards distance, from two feet to between three and four feet, and a bore hole a few feet farther to the dip went through six feet of coal. Showing that at a moderate depth we may expect to find it assume its full size. It was overlaid by oil shales similar to those over the main seam near Middle and East rivers, and in the overlying shales were found fossils similar to those above the main seam near Middle river.

St. Lawrence Area.—On this area which is near Merigomish harbour, and is the eastern extremity of the basin, explorations were carried on from February 1866 until February 1867, under the charge of a mining engineer and of a very competent oreman. The outcrop of the seam had been first struck by others; a pit was sunk one hundred feet deep, and levels driven from it. There appeared to be what miners call a 'saddle-back' where we sank. The dip was over 60°, but flattened greatly at a few hundred feet distance to the dip, and varied from S. W. to S. E. To the eastward the measures dip in a south-easterly direction, and lie at a very easy angle. The seam first found proved at a depth of one hundred feet to be fourteen feet from roof to floor, though near the outcrop it had not been as many inches thick. It was intended to have opened a colliery at this pit, as it is some miles nearer deep water than any other, but the disturbance at the spot selected will render it necessary to sink a new working shaft. The one now sunk will answer for a ventilating shaft. Numerous pits and bore holes have been sunk on the property in order to prepare for opening a colliery. A few feet from the last named seam another was found eight feet thick of very good coal. It has not been tested to the dip, and probably will prove to be an underlying bench of the other seam.

The explorations on the McBean area adjacent, show that the seams found on it must be found also on the St. Lawrence

area, which is probably on the northern side of the basin. A large amount of shales was found to overlie the seam proved by us. A few yards from the pit we found a reddish sandstone which occurs in great abundance along Sutherland's river, and dips generally at a very slight angle. It is probable that reddish sandstones on the Culton area are identical with those found on this area. The occurrence of sandstones in different localities cannot be counted upon, as the Albion mines, in sinking their Dalhousie pit passed through nothing but an immense mass of shales, while further west to their surprise they came down upon a light sandstone in sinking a shaft, and for a time at least abandoned it, supposing that the coal must have run out, and that the sandstone belonged to measures underlying the main seam. The same sandstone has been found in the overlying shales at New Glasgow and at Middle river.

I am disposed to think that the lower measures at Sutherland's river bridge are the equivalent of the New Glasgow conglomerate, and like it, are the boundary between the southern and northern basins, or as I have termed them, the Albion and the Pictou basins. The southern basin narrows and terminates a short distance to the eastward of Sutherland's river. I have found coal at its eastern extremity, and also have seen cannel coal discovered there. The explorations east of the river were merely superficial, being confined to examining exposures of strata and indications of coal. I speak therefore with some hesitation as to the country east of Sutherland's river. That there is coal there, may be safely assumed; but the extent of it must be settled by the miner's pick, and bore rod. No intuition can dispense with the drudgery and expense of practical explorations, which require a very small amount of science, and a very liberal expenditure of money.

The accompanying map of the Pictou coal district gives the boundaries of leases, &c., according to maps of the Mines Office.

Art. XII. On the Food Fishes of Nova Scotia. No. V. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(Read May, 1867.)

The Cod Family.

Gadus Morhua, (Lin., Gunther, Gill.) *Morhua Americanus*, (DeKay, Storer.)	The Cod.
Gadus Œglefinus, (Lin., Gunther.) *Morhua Œglefinus*, (DeKay, Storer.) *Melanogrammus Œglefinus*, (Gill.)	The Haddock.
Gadus Virens, (Lin., Gunther.) *Gadus Carbonarius*, (Richardson.) *Merlangus Carbonarius*, (DeKay, Storer.) **Pollachius Carbonarius*, (Gill.)	The Pollack.
Phyris Americanus, (DeKay, Storer, Gunther). *Physis Chuss*, (Gill, Schœpf.)	The Hake.

In my last papers which I have had the honour to read before you, you will recollect that I gave you all the facts I could collect on the herring, the gaspereaux, the mackerel, and the salmon and trout family. There remains now, the cod family, the halibut, and the shad, (which last is a congener of the gaspereaux,) to complete the food fishes of Nova Scotia. The subject of the present paper, will be the cod family—or the *Gadidæ*. Of this family we have four species, under two genera, which from their abundance in our waters may be considered as food fishes. One or two other species occur, but not in sufficient numbers to entitle them to this epithet. The common cod, the haddock, the hake and the pollack. Of all fish, this family has played the most important part in the world's history. The great northern sea kingdoms of Europe, the English, the French, and the Dutch, have from time immemorial pursued this fishery, which, commencing at their own door, and done in fishing boats, has extended successively to Greenland, and the North Sea,—to the Grand Bank of Newfoundland, and to our own shores. The fishing flats, have yielded to a vast mercantile navy, riding out the roughest gales in mid ocean, and filling our harbours with a forest of masts. Wars have been waged in this

* Dr. Gill considers this fish identical with M. Perpureus of Storer, (see synopsis fishes Bay of Fundy, &c.) If Storer's and DeKay's description are accurate, it cannot be so, I have never met with it myself.

cause—continents discovered and named from it. Cape Cod, cape Baccaro, the Magdaline penny with its obverse of a stock-fish, and the three diamond port, common at Newfoundland, all attest the estimation which the learned geographer, the wealthy banker, or the poor peasant in Portugal, who toils over his arid vines that he may exchange them for fish to keep the fasts of the church he loves so well, have held for centuries this fish in. More strange is it, to think that poised upon his ever fanning fins, fathoms below the ocean, he has been the unwitting agent in so many changes moral, material, and religious, on this earth's surface. But it is rather as he concerns our own Province that he is the subject of this night's paper, Our people, dwelling many of them on the sea-board, and none of them a day's journey from it—find in him an inexhaustible supply of food. The salt provision used of necessity except by the inhabitants of towns, is thus healthily varied, and the surplus easily cured, finds its way to the city in single quintals, in tens, or in hundreds, there to be exchanged for tea and molasses, or various clothing for the winter's cold. All along our seaboard dwells a marine population, half farmer half fisher, or "navigator" in provincial idiom, who steadily pursue this employment. As we have seen that the herring, the mackerel, and the gaspereaux, are surface feeders, and are thus dependent upon the winds and the various currents, which sometimes spread their food in acres, close beside our door, and again waft it away seaward for miles, and at all events spread it only in summer, and are thus uncertain in their movements and unconstant in their frequenting certain shores, and disappear always in winter,—so this family are bottom feeders, are certain in their feeding grounds, and always to be found both summer and winter. Thus the employment is certain and the supply regular. Following, as we have noticed before, the sun in his vernal path, these bottom feeders approach the shore in spring, from the deep soundings of sixty or seventy fathoms to which they had retired in early fall. It must be that the land and shallow waters warmed by the summer heats are now swarming with creatures which they hunt for food, and that in this pursuit they approach the land. During summer and early fall, cod are caught in various sizes, from the face of the rock to five or six

miles seaward. As the winter approaches he retires, until our fishermen have to put thirty miles of sea between them and their homes, and to pull him two lines and a half, or eighty fathoms, from his feeding grounds. No doubt these migrations are partial and that there always are fish on the banks that never migrate, and others that never leave our shores. Indeed one must believe that the fish on the grand banks of Newfoundland never migrate. We learn from Mr. Ambrose's very valuable paper that there are a succession of reefs or ledges parallel with our coast and running north-east and south-west, and that on these summits of submarine hills the cod resort,—the sickly fish resorting to the inshore ledges, whilst the finer and healthy ones with longer superior jaws and more prominent eyes, are taken in the mail steamers' track, and from whence Aspotagen, the highest land in the Province, is thrown upon the horizon, about thirty miles from the coast. The pursuit of food causes these migrations. Now, as regards food, it may be said of the cod as of most fish, nothing comes amiss, he opens his jaws and every thing slips down. To satiate a craving appetite is his perpetual instinct, and yet he has some discriminating tastes, he loves squid, he will not take salt bait on shore, though taking it greedily on the banks, among mollusks the glycemeris is very sweet to him. The stomachs of those taken on the banks are usually filled with herring, young cod fish, Norway haddock, young cat fish small mackerel, various mollusks, the glycemeris, and a large black coquog, and star fishes. Should he have indulged in fish spawn, it has probably been digested. This may be called his usual fare. Near in shore he picks up crabs and lobsters, and the mollusks, or sea shells, are much more numerous and varied. Of his casual fare may be enumerated grouse heads and entrails thrown over by some passing steamer, sea ducks, which he must have picked up floating near the surface, various stones dropped over by ballast boats or adherent to muscles which he has swallowed, (one of six pounds weight was long kept in the Halifax fish market as being taken from a cod's stomach). In Newfoundland he is said to follow the capelin and feed upon them. In New Brunswick, Perley says he follows the herring to feed upon their spawn and young fry.

I have never found a fisherman who had seen cod spawning, or seen their spawn floating like herring spawn on the water. According to the most intelligent, the female fish is heaviest, the spawn the largest, and escaping from her body when dead in greatest quantities during May and June. I therefore suppose they spawn in deep soundings, in greatest numbers, somewhat later than mid summer; others say later, perhaps both accounts are right; and as in studying the herring we found that there were two or more distinct spawns during the year, so it may hold true as regards the cod. During fall the young fry are abundant about our shores, and from analogy of other fishes, one would suppose a codling of six inches, was a first year's fish, and at that period six weeks or two month's old.

Description of a Cod taken from the Halifax market, 1867.

From a rather obtuse snout, the outline of head rises gently to the first dorsal fin, which has its anterior edge slightly posterior to insertion of pectoral, from thence declines gently to the tail, the body here is small and tapering. The lower outline descends from the tail quickly to a point just below the first dorsal fin, thence rising rapidly to the snout, forms a very stout bellied fish that tapers off to the tail; there are three dorsal and two anal fins, and the ventral fins are inserted anterior to the pectoral. Fish of this order have the pelvic bones, or those upon which the ventral and pectoral fins are based, joined by a hooked process to the bones of the head, instead of hanging unattached. The caudal fin is square, eye large, diameter one inch, irides brownish bronze; eye two diameters from tip of nose, nostril double, nearly half way between eyes and nose. Intermaxillary bones forming the upper jaw, which is longer than the lower, the lips are fleshy, the free end of the intermaxillary is square, and fits into a narrow pouch when the mouth is closed, —a deep sulcus through both intermaxillaries running beneath the snout. A small barbel about an inch long beneath the chin. The shape of the first dorsal pointed, higher than long third, ray longest, of the second roundish, and of the third rhomboidal. The pectoral is ovate, and the ventral is narrow with the fins and second rays prolonged into soft filiments. The colour of the head and back dark greenish ash, becoming lighter upon sides, a square spot of lighter green behind the eye. The chin, throat, belly, and lower parts white, with very minute black dots. This whole green colour forms a back ground for numerous yellowish bronze spots. In this specimen these spots are square, but in others they are ovate or circular, or like broken links of a chain, varying in character, but always present. The colour of the pectoral fins was light transparent green, the ventral with a border and two rays white, the dorsal, anal and caudal dark transparent green, with faint spots. Lateral line pure white and running in an arch to middle of second dorsal, then straight. In the upper jaw the teeth are contained in a lunated band passing round inside of the intermaxillaries, the mesial line being bare. An irregular row of small and larger teeth in lower jaw, the symphasis bare. A crescent of teeth on palatine arch and inside the mouth, above and in front of swallow, two roundish knobs of osseous substance, resembling the teeth of the sea-wolf.

Branchiostegal rays, 7, 1st D, 14, 2d D, 19, 3d D, 19, C about 45, 1st A 22, 2d A 17, V 6, P 19.

On opening this fish, the small single heart presented in front, a large light colored yellow liver covered the stomach and intestine running down the right side. Removing this the stomach appeared, with its pyloric end encircled with a fringe of numerous cœca. A short intestine was reflected upwards over the stomach and then descended to the vent, the gall bladder was filled with bile, the spleen was small and dark brown. Removing these, the sound or air bladder presented, strongly attached to the spinal column and its transverse processes; externally smoky white—internally, when cut into, pure white, but showing marks of extravasations of red blood in many parts. The membrane was firm and apparently fibrous, and lined by apparently serous membrane. Fibrous filiments seemed to run to each tranverse process of the back bone, as if the fish should have the power of compressing the bladder. This bladder extended from an inch below the vent, nearly to the gills, where it presented a wide front, from either corner of which there proceeded two tubes, which, arching rapidly at first, passed towards the gills, where the free end seemed to remain embedded in the muscle. These tubes were hollow, and easily traced by a wire from within the bladder to the free end, which was a closed sack. This specimen was about two feet long and weighed about three pounds. They vary in our markets from one pound up to eighty. There is a tradition of a fish being sold by Mr. Lisle, a merchant of Halifax, weighing, when dried, one hundred and fourteen pounds. When taken from the sea it must have been one hundred and fifty weight.

In speaking of the colour of the cod, I have described the individual specimen before me, but on examining many hundreds, or I may say thousands, exposed for sale in the Halifax fish markets, we find that this greenish ash runs through every shade, from dark blue green, to the lightest yellow ash, in different individuals. Some are so dark that the spots are scarcely discernible. The spots, themselves, vary in shape, in size, and arrangement, in different individuals. They are square, oval, in rings and in broken links, in different fish, and sometimes one fish has every kind upon him at once. They usually are bronze, but when first taken out of the sea, almost golden. There is a variety called rock-cod, with a brilliant red wash, and another with a bright yellow, superseding the green. There are others that have black blotches on the sides, called pine-trees by the fishermen, from a fancied resemblance. I consider them to be the Greenland variety called "Ogack" by Dr. Gunther.

In comparing our fish with DeKay's figure of the American cod, it agrees well with it in colour. It does not agree so well

with Couch's figure of the English cod, in colour, and the term "mottled" on the sides is scarcely a good description of the very defined spots which our cod has over his back and sides. Yet Dr. Gunther in his catalogue of fishes, (B. Museum,) considers the English and American cod identical, and is followed by Sir John Richardson. The American authors, except Gill, though admitting the English and Newfoundland fish identical, assert there is a distinct American variety. Unfortunately they do not give the exact differences in each. I have never succeeded in finding but one species in the many thousands I have examined, and this species tallies exactly with DeKay's description of the American variety, except a very slight variation of the number of fin rays, which is too variable a mark to be considered typical. I consider our fish identical with European, with Newfoundland, and the American variety of DeKay. I have little more to add of the habits of the cod. That following the surface feeders, the herring, gaspereaux, mackerel, shad, and capelin, he migrates from the deep soundings in spring, and returns in winter—that we are ignorant of his spawning time and grounds, (some Danish authorities have lately reported he sheds his spawn in mid ocean, at various depths,) that he is a bottom feeder and voracious eater, and that he attains above one hundred pounds in weight. I beg to refer you to the very curious, exact, and graphic paper by the Rev. Mr. Ambrose, (see Transactions Inst. Nat. Science, N. S., 1865 and 66,) on this subject.

A description of the catching of this valuable fish, divided into the shore and deep sea fisheries, merits a separate paper. The various materials used—the vessels, the boats, lines, seines and nets,—the moral, intellectual, and religious influences it exerts upon the homes, the habits, and character of those employed in its pursuits,—the political questions with foreign powers, arising out of it,—the questions of protections and of bounties,—the alleged increasing scarcity of fish, and the admitted increasing distances of the fishing grounds, and diminishing supply of bait, are all subjects of the highest importance to the Maritime Provinces. Twenty thousand of our fellow subjects, upon whom depend one hundred thousand

women and children, ply the oar, or whiten the ocean with their sails, or spread their nets upon the surface, or rake the bottom with their hooks and lines of that narrow neutral ground of banks and bars, bounded on the right by the great gulf stream, flowing north-east, and on the left by the cold arctic current, flowing south-west. Its opposite flowing surfaces teem with moving masses of life, its floor is paved with stationary mollusks.

Here a great Providence spreads a daily banquet. Here is perpetually solved the great problems of consumption and supply, of reproduction and destruction. Whales, porpoises, and seals; innumerable birds, either on the wing, or nimble divers in hordes that darkened the air, once thinned the excessive reproduction of these marine hosts. Man has stepped unto the scene, and they have all vanished, and it is for our Legislatures to determine his vicarious position, to amend it by severe laws and restrictions, if his waste or wants are in excess of reproduction; or, on the contrary, if with all his powers, he but healthily keeps alive over production, then it is for them to take off every restriction founded in ignorance, and to foster by bounties our toiling fellow subjects, who follow the sea for their living.

The Haddock.

Description of a haddock taken in Halifax harbour, December, 1867:—

Length, 20 inches, of head 5 inches, a small fish. Outline more elegant than cod, the profile slightly concave, and head carinated. The whole head more bony, the lips fleshy. upper lip longest, lower with a slight barbel, scales over the cheeks and side of head, nose pointed, nostrils double, small, with the eye placed high in the head, eye large, diameter 1 1-10 inch, nearly two diameters from tip of nose, irides silvery, with bronze spots, upper lips formed of the intermaxillary bones, the free end of maxillary fitting into a side pouch when mouth closed, teeth small and in irregular bands or rows in upper and lower jaws, none in palatine arch, two round osseous masses in upper jaw, a third in lower jaw fitting to the inside of throat, in front of swallow. The first dorsal triangular with the third and fourth rays prolonged to sharp points, posterior edge concave. The second and third dorsal one half height of first, triangular, one half as high as long. Caudal forked, ventral subjugular, white, rays prolonged to filiments, pectoral ovate, reaching opposite insertion of second dorsal. First and second anal triangular, generally inserted opposite second and third dorsal.

Fin rays, 1 D. 15, 2 D. 23, 3 D. 18, C. 35 or 40, P. 18–19, V. 6, 1'A. 24, 2'A. 21.

On being opened it presented the same appearance as the cod, large and thin lobed liver, numerous *cæca*, air bladder smaller, the two appendixes very

much smaller. The stomach was filled with sea urchins, star fish, shrimps, a small clam, and a pultaceous mass. Colour when fresh from the sea, bluish ash, with purple and golden reflections, becoming darker when stale, below silvery with minute black dots, scales larger than cod, colour of fins transparent, light purple, with light yellow edges, a black oblong spot above pectoral fin, halfway from insertion reaching to lateral line, lateral line black, arching from above the opercles, nearly to back of second dorsal, then straight to tail.

In studying the haddock, we find him a weaker fish than the cod, coming nearer the shore in summer, and retiring to a less distance in winter, choosing rather mollusks, and star fishes, and sea urchins, for his food,—migrating often in large shoals, and often seen grubbing with nose downward, on the bottom. He will take a fly from the surface, at times. He never attains a size above eight or ten pounds. As a merchantable fish, he has half the value of cod, not having thickness enough for drying, and is only taken when cod are scarce, except for supplying the fresh fish-market, or for curing as "Finnie haddies." When fresh, the superior flakiness of his flesh causes him to be preferred to cod. His spawning time is uncertain, or, perhaps, extended. In August females are taken filled with spawn in Digby basin. In the fish taken in December, the ovaries were about three inches long. With a rare want of natural history, fishermen consider him the fish St. Peter took the silver tribute from, the black spot upon his side being the mark of the Saint's fingers. Unlike the cod, he varies but little in his colour.

The American Pollack or Coal Fish.

Description of a Pollack taken in Halifax harbour, December, 1867 :—

Length 2 feet 11 inches, head 8½ inches, weight about ten pounds. The form of the fish is strait; the back line ascending but slightly from nose to top of back. The whole figure is round, and tapers to a small, handsome, and deeply forked tail, which is about the breadth of the fish opposite first anal's, anterior edge. The line of belly not prominent, and the fins proportionally small. The mouth is small, the lower lip longer than the upper, the eye large, nostrils double, and both sit well up in the head. Diameter of eye 1 1-10 inch, and about 3½ inches from tip of jaw. The upper lips are formed entirely of the intermaxillaries, and the free end of the maxillaries enter a cheek pouch when the mouth is closed. There are three small dorsal, and two small anal fins, the pectoral fan shaped, and ventral reduced to a few filiments. The first dorsal is triangular, nearly as high as long, fourth ray highest; the second dorsal begins more than an inch from the first, is double its length, and about its height, third ray longest; the third begins nearly two inches from the second, it is a little longer and not so high as first, the

fourth ray longest. The tail is handsomely forked and about the breadth of the fish opposite beginning of first anal. The first anal opposite third dorsal, about its length and half its height. Second anal reaching from opposite insertion of second dorsal to a little beyond posterior edge of first dorsal, vent one inch and one line anterior to it, and opposite last third of first dorsal. Colour, head and upper parts, to a little below lateral line, dark blackish blue; below, silvery dotted with minute spots, lips black, a little brownish on cheeks, chin and branchiostegal rays blue, pectoral, caudal, and dorsal fins dark blue, anal light blue, with white base, ventral white, lateral line white, nearly straight, narrow at first, it becomes broader and further from line of back as it approaches the tail, scales moderate, oval slightly striated, covered with nacre, and but a small part exposed. They cover the cheeks and side of head, and run up the base of tail. Numerous small teeth contained in an irregular band extending round the symphasis of upper jaw, a small notch in band at symphasis, a similar band extending round lower jaw, a small triangle of teeth on palate bones,—irides silvery with greyish lines.

On opening the fish the heart has three cavities, the first pearl color; liver with three lobes, right longest, middle short, numerous cœca, and air-bladder extending from gills to beyond middle of the first anal, firmly adherent to spine, with two large anterior pouches with a small filiment attached to each. I could discover no communication with gills. There were the same osseous tubercles in front of swallow as in cod.

Branchiostegal rays, 7, 1'D 12, 2'D 1 S, 3'D 19, C not counted, 1'A 23, 2'A 18, P 19—29, V 7—8.

In studying this fish we find a greater divergence from the type of Gadus. A small and fine head to which the small snout and projecting lower jaw give a less powerful appearance. We find a round tapering body, set off with a very beautiful tail and strikingly coloured with its white lateral line and dark sides. It is lively in its motions, especially the young, who keep in shore and in shallow waters doubtless for protection. They take the fly very readily at that age. They frequent the North West Arm at Halifax in numbers, and are seen in solid masses in thousands going in and returning on the tide at Digby basin. As far as the eye will reach a dense moving mass is seen slowly passing the pier head at Digby for hours, a few feet below the surface. Apparently as they become older they become bottom feeders, not approaching the surface. Their flesh when fresh is inferior to haddock or cod, wanting their firm flakiness, yet very superior to the fresh water trouts and lake salmons. When cured it brings a less price in the market. I have never seen but one species on our coast. DeKay mentions two, which Gill by his reference to Perley considers identical.

The Hake.

Description of a hake taken in Halifax harbour, December, 1867:—

Length two feet six inches, length of head seven inches. The outline rising from a moderately pointed snout runs gently upward to insertion of first dorsal, then tapers to a very small tail. The lower outline descends from tail to nearly the middle of pectoral fin, then rises rapidly to nose. A large bellied fish, with projecting upper jaws, thick shoulders, and very tapering tail. The eye large, set well up in the head, one inch diameter, two and one-half inches to tip of nose, nostril double, very close to upper edge of orbit, mouth large, upper lip formed of intermaxillary bones, free end of maxillary fitting into a side pouch, profile slightly concave, lip not so fleshy as cod, a band of at least five rows of small teeth pointing inwards lines the intermaxillaries, the symphasis bare, the lower jaw the same, with symphasis bare, teeth on palate arch in a triangle, all pointing downwards. The scales are moderate, ovate, slightly striated and cover the opercles and greater part of head, the opercles with a sharp point on posterior edge. First dorsal very small, rising about nine inches from nose, fourth ray prolonged into a long filiment, second dorsal about an inch behind first and extending to within an inch of tail, tail very small and ovate. The anal fin extends from opposite posterior insertion of second dorsal to opposite three inches posterior to its anterior insertions. Pectoral long ovate, ventral very far forward and reduced to a single filiment five inches long and with a double termination. Colour, light reddish brown on back and sides, head and cheeks white with minute brown dots. The dorsal, caudal, and pectoral fins follow the general colour, but lighter. The anal has the base white, edged black, and the ventral filiment is white. The lateral line is black and follows generally the outline of back, but always keeping near to the back. The scales are ovate, striated, and of medium size. The inside of mouth is black. There is a most minute barbel on lower jaw. The upper jaw the longest.

Rays 1 D. 10, 2 D. 55, C. 24, A. 47, P. 14. V. a single filiment.

The intestines of this fish are similar to the Gadidæ, except the sound or air bladder; this lies unattached to the spine, loosely adherent to the lower side of the intestines; its edges are beautifully fimbriated by a series of trifoliated processes. It is highly vascular, turning light pink when exposed. As in all the other members of this family, there are anterior processes as in the pollack, and anterior sacks as in the haddock and cod, projecting from the front, so, too, here the analogy is preserved by the anterior fimbriæ being double those of the sides. Whatever reason for supposing the other members of this family can compress their air bladders exists, it can not be the case in this, it being impossible to compress a loosely attached bag, resting on no firm base. The air within must be the product of secretion, as there is in none of them any external communica-

tion. In all I have examined, I have found what seemed difficult to determine, whether it was extravasated blood, or a reticulated plexus inside of the bladder. In every part of a fish one meets with quantities of extravasated blood, answering to the terrible convulsions and flappings of dying fish.

In studying the hake we find that he departs still more widely from the type of the family. His fins runs into a continuous range, his tail is very small, and as in the pollack, we found a lengthened lower jaw, giving a less powerful, or less rapacious look, so we cannot but admit that in the hake the large head, concave profile, projecting upper jaw, and bands of teeth all projecting downwards, give him a shark-like look. Hake are repeatedly drawn to the surface by their hold upon a hooked fish, and not seldom seem loth to quit their prey. A hake was caught by a set-line in Digby basin, having swallowed a haddock previously hooked, and thus entangling himself on the already occupied hook. Among fishermen he enjoys the character of a lively, saucy fish. He prefers muddy bottoms, and takes bait best at night. He also takes refuge in fresh ponds having outlets to the sea, and is said to winter there. He is caught during winter, in deep soundings on the banks, but not in such numbers as the cod. His flesh, either fresh or salted, is much less palatable than the others of this family.

In this paper I have used the nomenclature of the British Museum (Dr. Gunther), though giving the synonymes of the American writers, wherever I could obtain them. These last have followed Cuvier and Vallencennes with the exception of Dr. Gill, (Smithsonian Institute), who has reclassed the whole subject, whilst the former has returned to the old Linnean names, superseded apparently for no cause or for better generic terms, by Cuvier.

NOTE.—I have spoken of the maxillaries and intermaxillaries as being received into a side pouch when the mouth is closed. Anatomically speaking, both maxillaries and intermaxillaries are received into a side pouch, in all this family. This arrangement has its widest divergence in the ground Shark (S. Borealis Yarrell,) where the maxillaries become cartilaginous, and covered with red mucous membrane—in fact a gum is received into a pouch lined also with red mucous membrane, which is in fact a secondary mouth.

Art. XIII. On the Geological Features of the Londonderry Iron Mines. By Rev. D. Honeyman, D. C. L., F. G. S.

(Read January 7, 1867.)

These mines are situate on Great Village river on the south side of the Cobequid mountains. Their history, previous to 1855, and the opinions until then entertained by the geologist as to the character, age and origin of the iron deposits, are fully given in Dr. Dawson's *Acadian Geology*. The following observations may be regarded as a sequel to the history just referred to. They are the result of two visits which I made to those mines in preparing illustrations of the resources of the Province for the London International Exhibition of 1862, and Paris Universal Exhibition of 1867. On my first visit I found in operation one blast furnace and several puddling furnaces. The ores employed were brown hematite and specular. The flux used was a limestone derived from a lower carboniferous deposit, existing about three miles west of the mines, and the fuel used was charcoal made from the hardwood of the neighbouring forest. A massive Nasmyth hammer was constantly at work forming bars of charcoal iron, which were chiefly exported to England. The specular ore was derived from a bed about three feet thick, and the hematite from a bed of variable thickness and of unknown depth. In order to ascertain the depth pits had been sunk, but without any definite result. My last visit was of a much more satisfactory character, and the information acquired is of the most interesting and singular description. I found the works considerably extended by an increase of the number of puddling furnaces, and by the addition of rollers for the manufacture of bars and rods of iron. An attempt had also been made to manufacture cast steel, with the most satisfactory result. So that now there are here manufactured,—

Pig iron of the finest quality,
Charcoal iron,
Puddled steel,
Cast steel.

Dr. Percy's analysis shows the character of the Pig iron.

A suite of specimens, forwarded for the Paris Exhibition consist of:—

Pig iron,
Charcoal iron,
Puddled steel,
Cast steel,

Which satisfactorily illustrate the variety and completeness of production of the Acadian iron works. I have no doubt that they will confirm in Paris the character that has been gained in the Exhibitions of London 1851–1862, and Dublin, 1865.

The brown hematite is now the only ore available for the production of iron, the specular ore, already referred to, having been apparently exhausted. The supply of ore, however, has not been affected by the failure of the specular ore, as another great bed of hematite has been discovered of dimensions nearly equal to the bed already referred to. These two beds are now distinguished respectively as the north and south. The strike of the beds is east and west, their dip is 80° south. At Martin brook, they appear about thirty feet apart. The maximum thickness of each of the beds is twenty feet, and the average of the north is five feet and of the south four. Very often the beds are interrupted and disappear. The unequal thickness of the deposit and interruptions are marked by the inequality of excavation at Martin brook. Their length has been ascertained as at least twelve miles.

In the vicinity of Martin brook, where the hematite has been chiefly extracted, the course of the beds was found to be west by south. The cause of this deviation was a subject of conjecture. A level was driven obliquely to the strike for drainage in the meantime, and ultimately for the extraction of the ore. When this level reached the hematite beds at about one hundred feet below the surface, it was found that a great slip had occurred, that the beds had been cut off, that during the process a stratum of clay had been formed between the upper and lower part, the inclination of this stratum being about 20° south-west. This interesting revelation explains the mystery of the deviation already referred to, and at the same time shews that the deposits extend downward to the extent indicated by the level. As the

beds at the point of section have not degenerated in thickness or quality, they may be regarded as only an interruption.

Another level is being formed some feet under the other, and at right angles to the strike of the strata. This is expected to reveal the existence, or non-existence of the hematite beds, and it is reasonably expected that if they shall be recovered, they will be found in regular position, and more advantageously situated for mining purposes. It was supposed that the hematite was an altered ankerite, and that it would only be found in the top of the vein. Whatever may have been the original character of the ore when deposited, it is certain that the hematite extends to a depth of at least one hundred feet, and that its character in the level is precisely the same as it is in the excavations near the surface. I found cavities with butryoidal crystalizations of hematite in the roof of the level, as well as in the excavations above. The hematite of these beds is chiefly amorphous and friable, with numerous masses porous and compact, and mamillary butryoidal, and stalactitic crystalizations of striking variety of form.

Often the ore has an unmistakeable *cokelike* aspect, being specular and intermixed with slate, reminding me of the coke made from the fine coal, with intermixed slate, at the Acadia coal mines. This, and numerous other appearances in the ore, can only be satisfactorily accounted for by the supposition of metamorphism, by igneous agency. If, again, we are to suppose that the hematite is metamorphosed ankerite, the rarity of the occurrence of this mineral in the excavations at Martin brook, shew that the metamorphism has been complete. I shall now direct attention to the geological relations of these hematite beds.

The section represents the several geological formations existing in the Cobequid mountains, and also to the south of these, from the centre of the Cobequid mountains, to the Cobequid bay. In ascending order, the formations are silurian, devonian, carboniferous, and triassic. These are severally included in the ten miles represented in the section. The line of section is along a portion of the new Amherst road, the Great village river, and the shore from Great Village to

the Cobequid bay, one and a half miles. The north of the section represents the rocks from the centre to the bridge above the mines, a distance of one and a half miles. The extreme rock is syenitic, and is situate about three miles west of what is called the sugar loaf, which is considered to be the highest mountain of the range. In this part of the section we have altered strata, which bear a striking resemblance to the altered silurian near Arisaig pier, county of Antigonish. These are quartzite ore, with slaty cleavage, breaking readily into rhomboidal forms. These are sometimes divided by true granite. I was astonished at finding granite associated with these rocks, as I have not met with it elsewhere similarly associated. On referring to the *Acadian Geology*, I find that granite occurs elsewhere in the Cobequids, and in the same geological position. I was equally surprised about five years ago in finding granite in the Baddeck mountains, Cape Breton, where I had expected to find syenite, as in the Antigonish and Cobequid mountains. Still I believe the two cases are not analogous, and that the geological relations are different. I consider the Baddeck granite as identical with that of our lower silurian of Guysboro' county, &c., and I regard the auriferous slates of Wagamatcook, associated with the granite, as also of lower silurian age. The granite of our section has also connected with it as intrusive rocks, several dykes of dark pyritous trap, which have forced themselves up between the siliceous silurian strata, converting them, as at Arisaig, into porcelaneous jasper, obscuring the stratification. This trap appears in one case crowned with these strata, having failed to force its way to the surface.

I have assigned to these strata a silurian age, in consequence of their resemblance to the strata of Arisaig, of which the Frenchman's barn is a part. They also bear the same relation to the argillite here, as the supposed equivalent do to the argillite of the Antigonish, Ohio, and Merigomish mountains. I consider that it is not at all likely that we shall have any evidence more satisfactory than this to determine the geological age of the strata in question, at least in this locality, as the proximity of the trap must have destroyed organic remains as

in the case of Arisaig pier and the Frenchman's barn. It is possible, however, that an examination of the Arisaig equivalents at Earltown, on the north side of the Cobequid range, with their fossils, may enable us to determine the precise age of the strata under examination. Succeeding these, and toward the south, we have a thick series of strata, which in the line of section form a mountain of considerable elevation. These are readily distinguishable from those already described, and are divisible into three members. Members 1 and 2 are separated by the beds of hematite already referred to—1 being the underlying and 2 the overlying rocks. It has ever been supposed that these are the first tokens of the different geological periods—1 being supposed to be silurian, and 2 and 3 devonian—1 is found to be much harder than 2 and 3. The miners distinguish 1 and 2 by their difference in hardness. The thickness of the series may admit of a separation into periods, which may not be admissible on lithological grounds so slightly distinctive. 3 is more readily distinguished from the two preceding, by its darkness of colour and softness. The latter property gives depression to the surface of the ground which these last strata underlie, as the superior hardness of the former gives a corresponding elevation. Succeeding the devonian strata are conglomerates and sandstones of the carboniferous period. Preceding the formation there must have been an elevation of the strata already described, and that, too, at the same period as the corresponding strata elsewhere—that is, at the close of the devonian period. It is probable that the rocks then formed had not undergone the metamorphosing process by which they assumed their present character. I consider that in the manner of their deposition and in the time of upheaval, the sedimentary rocks resemble their Lochaber equivalent.—*Vide Geology of Antigonish County*. On the shore formed the shallow seas of the carboniferous period accumulated the shingles which now constitute the conglomerate, and afterward the series of sand stones, shales and clays, which are found reposing on these. The limestones are not found resting on the conglomerate as in Antigonish county, but limestones are found elsewhere in their usual position on the side of the Cobequids; and I have already mentioned

the limestones used in the manufacture of iron, occurring about three miles west of the mines. I was informed by Mr. Jones that these limestones succeed the devonian slates without the intervention of the conglomerate. This lower carboniferous conglomerate of our section now occupies an elevated position, more so indeed than the 3 members of the devonian series and a part of the sandstones resting on these conglomerates dips in the same general direction as the older rocks. I consider that the upheaval of these lower carboniferous strata and the metamorphorsis of the silurian and devonian formations were simultaneous, and that both were caused with similar operations at Polson's Lake. *Vide Geology of Antigonish.* The upheaving and altering agency appears to have been the trap which I have already referred to as in connection with the silurian strata of our section. To this period and agency I may therefore ascribe the metamorphic and igneous phenomena of the iron beds to which I have already alluded, and to the disturbing influence of the trap eruption I would attribute the great slip by which the rocks and iron beds at Martin brook have been divided. Succeeding these silurian, devonian and lower carboniferous strata, we have a broad band of carboniferous strata in the opposite direction, or synclinal to those already described. Succeeding these again we have another broad band of strata of triassic age, dipping in a direction opposite to those immediately preceding, the anticlinal axis being situate between the two formations. This triassic series is composed of a coarse conglomerate of considerable thickness, with interstratified sandstone which had been formed of and deposited on the carboniferous sandstone on the shores of the triassic sea. These again are succeeded by coarse red sandstone of the same period. This conglomerate and its sandstone now rise, with the strata immediately beneath, to a considerable elevation, and dip with a high angle in the same proportion as do the carboniferous strata of which they form the anticline. I have not been able to ascertain the nature of the elevating cause. There can be little doubt that it is trap, apparent or concealed, such as is to be met with at Two Islands, Five Islands, &c.

The new line of railway being constructed between Truro

and New Glasgow, furnishes a noble section of the band of strata which we are now considering. Leaving the West river station, on the way to Truro, we see on either side of the road fine specimens of argillite which flank Mount Tom on the west, succeeding the basal felspathic rocks. These exposures continue for several miles. The argillite of these cuttings appear to be very little, if in any degree, altered, and it it quite possible that fauna might be found in them which may more directly indicate the age of the altered or unaltered pre-carboniferous strata of the band, than even the Earltown group, already referred to. When we leave the section of argillite strata on the Truro side of Georgetown, there appeared to be some obscurity for some distance, and then succeeding are magnificent cuttings of carboniferous strata, showing a dip apparently synclinal to that of the older strata. Somewhere in these strata must be situate the manganese limestones of Salmon river. Succeeding these carboniferous strata cuttings are cuttings equally imposing of triassic sandstone, which reach nearly to the town of Truro.

I would observe, in conclusion, that the lines of railway from Halifax to Windsor, and from Halifax to Truro, now reveal and make accessible to the observer the great geological features of the Province. Proceeding from Windsor to Mount Uniacke, we pass through the granite which may be regarded as the basal rock of the Province; passing on to the junction of the Windsor and Truro lines we rise into the quartzite and argillite of the metamorphic lower silurian, which includes Mount Uniacke gold field. Proceeding from the junction to Truro, we pass from quartzite through argillite and quartzite, all lower silurian. Leaving Elmsdale, and approaching Shubenacadie, we reach the lower carboniferous limestones with their gypsum. Leaving Truro for Pictou, we pass through the series that I have already described, descending geologically through triassic, carboniferous, devonian and upper silurian, this last being, in all probability, the immediate successor of the auriferous lower silurian. From West river station to Pictou harbour we probably ascend through the extension of the silurian series of Springville, East river, through the lower carboniferous of Hopewell, then the middle and upper carboniferous. In various localities we pass through drift and alluvium, and thus we have a synoptical representation of the Geology of Nova Scotia.

APPENDIX.

ABSTRACT OF METEOROLOGICAL REGISTER, HALIFAX, NOVA SCOTIA, LAT. 44° 39′ 26″ N., LONG. 63° 36′ 40″ W.

1866.	Thermometer.				Barometer.				Winds.		Weather, &c.								
Month.	Max.	Mean.	Min.	Range.	Max.	Mean.	Min.	Range.	Most prevalent.	Least prevalent.	Rain fell on	Snow fell on	Hail fell on	Fog on	Aurora Borealis	Solar Halos on	Lunar Halos on	Lightning.	Thunder.
											Days.	Days.	Days.	Days.	Nights	Days.	Nights		
January. . .	43°	20°	–15°	58°	30·26	29·62	29·12	1·14	N. W.	E.	6	10	. .	5	2	2	2	. .	. .
February. . .	52	25	–7	59	30·36	29·76	29·04	·32	S. W.	E. & S.	7	7	. .	5	2	. .	3	. .	. .
March.	55	29	10	45	30·12	29·55	29·05	1·07	N. W.	E.	6	12	. .	5	5	. .	2	. .	. .
April	70	40	26	44	30·24	29·58	29·00	1·24	N. W.	E.	13	2	. .	8	2	. .	. .	1	1
May.	66	47	31	35	29·79	29·42	28·79	1·00	S. W.	E. & W.	18	3	1	6	2	. .	1	. .	. .
June.	89	56	39	50	29·89	29·60	29·34	·55	S. W.	E.	12	. .	.	7	1	1	. .	1	2
July.	87	61	50	37	29·34	29·64	29·32	·52	S. W.	E.	13	. .	. .	8	2	. .	. .	1	. .
August	78	62	47	31	29·82	29·58	29·13	·69	S. W.	N. & E.	13	. .	. .	2	6	1	1	2	5
September . .	74	58	39	35	30·03	29·69	29·29	·74	N. W.	E.	16	. .	. .	6	5	. .	. .	. .	1
October. . . .	68	45	28	40	30·08	29·72	29·28	·80	N. W.	S.	9	3	. .	6	6	2	3	. .	. .
November. .	58	38	23	35	29·97	29·67	29·24	·73	N. W.	E.	12	3	. .	2	. .	1	. .	1	1
December . .	50	28	0	50	30·06	29·60	29·05	1·01	N. W.	E. & S.	9	12	2	1	1	1	. .	. .	. .
Yearly. .	. . .	42	. . .	104	. . .	29·62	. . .	1.57	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

Mean Temperature and Atmospheric Pressure of the Different Seasons, from 1863 to 1866, inclusive.

SEASON.	1863.		1864.		1865.		1866.		MEANS OF 4 YEARS.	
	Thermometer.	Barometer.	Thermometer.	Barometer.	Thermometer.	Barometer.	Thermometer.	Barometer.	Thermometer.	Barometer.
WINTER.										
Mean	*26°	*29·70	25°	29·71	24°	29·58	23°	29·66	24°	29·66
Range	*62	*1·60	54	1·83	54	1·78	67	1·85		
SPRING.										
Mean	37	29·66	37	29·58	41	29·73	39	29·52	39	29·62
Range	81	1·35	35	1·38	67	1·23	60	1·45		
SUMMER.										
Mean	61	29·73	61	29·70	60	29·67	60	29·61	61	29·68
Range	49	0.98	55	1·00	49	0.76	50	·76		
AUTUMN.										
Mean	50	29·76	47	29·65	47	29·60	47	29·69	48	29·67
Range	69	1.21	51	1·09	65	1·45	51	·84		
Yearly Means	44°	29.71	43°	29·66	43°	29·65	42°	29·62	43	29·66

* Two months only, January and February, 1863.

SUGGESTIONS ON THE IMPORTANCE OF CONTINUOUS METEOROLOGICAL OBSERVATIONS.

(Read Nov. 5, 1867.)

INDICATIONS so unmistakably exist of great changes in the physical condition of the surface of the earth, that it becomes an interesting and not unimportant enquiry, whether the existing physical condition of the countries we inhabit are likely to be permanent, and if not, at what rate, and in what direction change is likely to occur.

The materials for such an enquiry can be obtained only by a careful registration of continuous observations for a long series of years, and comparison of the mean results.

There can be little doubt that the habits, feelings and characteristics of the various races of men who differ so widely from each other, have, to a considerable extent, been produced by the nature of the countries they inhabit; and that a change of locality, or a change of physical condition, must tend to modify the character of any given race of men.

That the Arctic lands—now the desolate region of perpetual ice—once enjoyed a climate suited to the growth of forest trees, is no less certain than that the warm, wine-producing districts of Southern Europe, were at one time a rugged waste surface of ice and snow. The period occupied by such great changes can hardly be estimated, but it seems probable that some of them have taken place since the first appearance of man on this earth.

It seems also probable that the causes of these changes are still in operation, and that variations in the temperature and physical condition of many parts of the world, are now in progress.

To watch for the signs of such changes, to discover in what direction they tend, and to attempt to estimate the influence they may exercise on the habits and character of our descendants, cannot but be both an interesting and important subject for consideration.

It will be easy, for instance, to imagine how serious an effect would be produced by a change of a few degrees in the mean temperature of the winter months in Nova Scotia.

If the temperature were lowered, the harbour of Halifax would probably be closed, or nearly so, for some months, and the commerce of that city seriously impeded. Most of the smaller harbours would be rendered entirely inaccessible except during the short summer. The commencement of all agricultural operations would be deferred for some weeks, and the autumn season abridged to the same extent. The increased length of winter would enhance the trouble and cost of keeping live stock, and no doubt many species of wild flora and fauna would become extinct. The effect too, which severe frost has on the rocks and surface soil would be so increased and extended as, in the course of a few years, to alter the appearance of the country and modify the relative proportions of land and water.

If on the other hand, the change were in the other direction, it would bring direct and substantial benefits to all the inhabitants of the country. The harbours would remain permanently open, and all farming operations would be facilitated and lessened in cost. It is however probable that increased temperature might, by diminishing the rainfall, and increasing evaporation, so decrease the depth of water in the lakes and the volume of the rivers and streams, as to lead to important changes of the surface of the country, and perhaps ultimately to exercise a prejudicial effect on agricultural operations.

It might even be possible to estimate approximately the amount of pecuniary loss or gain which change of temperature would cause to the country, and to reduce degrees Fahrenheit to an equivalent in dollars!

In addition however to these merely theoretical considerations, there are practical advantages of great importance to be obtained from meteorological observations.

The state of the weather has immense influence on all our operations even on land, but to all engaged in maritime pursuits the weather has an importance which cannot be over-estimated. And if it be possible to foresee the approach of good or bad weather, and to warn the farmer to save his crops and the seaman to make for or remain in port, such a faculty will enable us to prevent the loss of immense wealth and invaluable human life.

That the state of the weather depends (as do all other operations of nature) on invariable and ascertainable laws, is certain and incontrovertible. But it is equally certain that these laws are as yet unknown or very partially known to us, and that they can become known only by the accumulation and generalization of an immense body of facts.

To contribute even in a small degree to bring on the day when the weather can be predicted with tolerable certainty a week or so in advance, is an object worthy of the attention of a Scientific Institution.

In England as in the United States, this subject continues to occupy the careful attention of scientific men, and though much remains to do, very valuable results have already been attained.

I need only point to the weather "forecasts" of the late lamented Admiral Fitz Roy as an example. Receiving by telegraph each morning the state of the Barometric column at many parts of the coasts of the United Kingdom and of the continent of Europe, the Admiral communicated his expectations as to the weather to most of the ports frequented by shipping, and a simple system of signals indicated the probable approach of a gale and the point from which it might be expected.

Although not in every instance correct, there is no doubt that these signals have been the means of saving life and property to a large extent.

With these few remarks I venture to urge on the Institute of Natural Science the importance of promoting careful and continuous records of the meteorology of the country, and to submit for consideration a few suggestions as to the mode of taking observations.

The instruments should be by the best makers, and all carefully compared with a standard instrument, either at the Royal Observatory, Greenwich, or at one of the United States Observatories.

All the instruments (not self-registering) should be read at stated times—say at 9 A. M. and 3 P. M., and oftener if possible; but if by any accident the observation cannot be taken within a few minutes of the prescribed time, the reading should be omitted altogether.

Observations, as to the correctness of which there is any doubt, are worse than useless.

At least six thermometers should be used, four of them self-registering; one to give the maximum temperature in the shade, and one in the sun; one to give the minimum temperature, about four feet from the ground, and one on the surface (if possible) of grass. A pair of thermometers, one with a wet and the other with a dry bulb, should also be suspended about four feet from the ground, and from these instruments all the observations necessary for calculating, the hygrometric condition of the atmosphere may be obtained.

There is, I believe, an efficient aurmometer fixed in an admirable position at Halifax, and I have no doubt that the results obtained from that instrument would be placed, by the courtesy of the Royal Engineers, at the service of the Institution of Natural Science. The estimate of the amount of rain-fall in the year would be attended with some difficulty, owing to the low temperature of the winter months and the consequent

necessity for melting the snow and ice collected in the guage; but the results, if carefully obtained, would, for that very reason, be peculiarly interesting and useful, and would fully repay the trouble of obtaining them. I have no doubt that the ingenuity of members of the Institute would devise an apparatus for this purpose, suited to the difficulties of the climate.

Careful and regular readings of the barometer have a peculiar value and utility. The time may not, perhaps, have yet arrived when a regular system of "forecasts," such as was introduced by Admiral Fitz Roy, can be adopted in Nova Scotia. But I venture to point out how admirably Halifax is situated for such a purpose, as the state of the Barometer could be known by telegraph from Newfoundland, Cape Breton Island, Boston and New York, as well as from other points, and the direction and force of air currents thus ascertained. If it be premature to attempt at present so extensive an arrangement, I would suggest that in a port so much frequented as Halifax is, it would be of great use to shipping to indicate daily, by a simple semaphore placed in a conspicuous position, the height of the barometric column, and whether it be rising or falling.

I beg to subjoin a table giving the means of a number of observations of temperature taken in the Naval Yard, Halifax, during the years 1863, '64, '65, '66.

I am not disposed to place much value on these results as it is probable that the instruments were faulty, nor can I be sure that the observations were taken with care, but I lay them before the Institute, as I presume no other observations are in existence for the same period.

EDGECUMB CHEVALLIER.

Number of Days on which Rain, Snow, and Hail fell in the different Seasons, for four years.

SEASON.	1863.			1864.			1865.			1866.			TOTAL OF 4 YEARS.		
	Rain,	Snow,	Hail,	Rain.	Snow.	Hail,	Rain,	Snow,	Hail,	Rain,	Snow,	Hail,	Rain,	Snow,	Hail,
Winter....	*13	*11	..	18	26	..	22	39	1	23	26	..	76	102	1
Spring....	28	12	..	32	14	1	43	8	1	37	17	1	140	51	3
Summer....	31	..	..	32	..	1	31	..	..	38	..	..	132	..	1
Autumn....	36	3	..	32	3	2	39	8	1	37	6	..	144	20	3
Total.....	108	26	..	114	43	4	135	55	3	135	49	1	492	173	8

* Two months only, January and February, 1863.

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

PATRON—His Excellency the LIEUTENANT GOVERNOR.

COUNCIL, 1866.

J. M. JONES, ESQ., F. L. S., *President.*
Lieut.-Colonel HARDY, R. A.,
Dr. J. BERNARD GILPIN, M. D., M. R. C. S., } *V. Presidents.*
Captain LYTTLETON, *Treasurer.*
WILLIAM GOSSIP, ESQ., *Secretary.*

Colonel MYERS,	W. C. SILVER, ESQ.,
Dr. DEWOLFE, M. D.,	P. S. HAMILTON, ESQ.,
JOSEPH BELL, ESQ.,	Captain KING, R. A.
J. H. DUVAR, ESQ.,	Prof. LAWSON, *Dalhousie Col.*

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

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

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. II. 1867-8. PART II.

CONTENTS.

HALIFAX, NOVA SCOTIA—WM. GOSSIP, 87 GRANVILLE STREET.
LONDON—REEVES & TURNER, 196 STRAND.
1869.

PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME II. PART II.

Anniversary Meeting, October 9, 1867.

In accordance with the Bye-Laws of the Institute, the Anniversary Meeting was held on Wednesday, October 9, 1867, at 8 p.m., when the following gentlemen were elected office-bearers for the ensuing year:—

President—J. Matthew Jones, F. L. S.

Vice-Presidents—J. Bernard Gilpin, M. D, J. R. DeWolfe, M. D.

Treasurer—W. C. Silver.

Secretary—W. Gossip.

Council—J. Hunter Duvar, P. S. Hamilton, Joseph Bell, Capt. King, R. A., J. Rutherford, Capt. L'Estrange, R. A., T. F. Knight, J. Campbell.

Ordinary Meeting, November 4, 1867.

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

Professor Lawson (Dalhousie College) read a paper by Professor How, of King's College, Windsor, which was a continuation of his former "*Notes on the Economic Mineralogy of Nova Scotia.*" (*See Transactions.*)

The President read a paper entitled, "*Contributions to the Natural History of the Bermudas—Corals and their allies.*" Specimens of every species described were exhibited, including a singularly formed *Mycedium fragile.* (*See Transactions.*)

Ordinary Meeting, December 2, 1867.

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

Dr. J. B. Gilpin read a paper on "*The Food Fishes of Nova Scotia,*" being the fifth and concluding part of a series delivered under that title. (*See Transactions.*)

Dr. Sterry Hunt, F. R. S., stated that the Shad was taken as far up the St. Lawrence as Montreal.

A Member, in alluding to the taking of the different kinds of edible fish on the north-east coast of America, remarked upon the local fishery laws at St. John, New Brunswick, which apportioned the harbour in lots to fishermen, a measure found to work well, as the whole harbour was thereby kept in a state of strict preservation as regards its fisheries.

The PRESIDENT read a short note "*On Hyla squirella*, a batrachian new to the Province." (*See Appendix.*) It was discovered by Mr. ARTHUR SILVER on his father's estate at Preston.

ORDINARY MEETING, JANUARY 6, 1868.

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

Dr. FRASER read a paper "*On the Magnetic Telegraph.*" (*See Transactions.*)

Dr. J. B. GILPIN read a paper "*On some of the Fishes of the Coast.*" (*See Transactions.*)

The Pollack (*Gadus virens*, Gunth.), and the Hake (*Phycis Americanus*, Gunth.) were described, and very carefully prepared drawings of each exhibited

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ORDINARY MEETING, FEBRUARY 3, 1868.

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

Mr. T. F. KNIGHT read a paper "*On Oyster culture.*" (*See Transactions.*)

Mr. J. H. DUVAR stated that an attempt had been made at Prince Edward Island to form oyster beds, but the result had not yet been ascertained. The oyster was found at various places on the Atlantic coast of Nova Scotia, but chiefly on the northern shores, within the Gulf of St. Lawrence, viz., at Pictou, Tatamagouche, Merigomish, Wallace, Pugwash, &c. They did not exist on the Bay of Fundy shore of Nova Scotia.

Mr. HENRY POOLE'S paper "*On the Meteorology of the Caledonian Coal Mines, Cape Breton, in* 1867," was read by the SECRETARY. (*See Transactions.*)

ORDINARY MEETING, MARCH 3, 1868.

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

The following Resolution having been duly moved and seconded, was carried by the vote of a majority of the members present:—

"That for the future the Ordinary Meetings of the Institute, for the reading of papers, be held on the second Monday of each month, instead of the first, as formerly."

The PRESIDENT read an extract of a letter from Dr. A. GÜNTHER, F. R. S., (British Museum,) relating to his recent discovery as to the Whitebait of England (*Clupea alba*, Yar.) being merely the young of the common Herring (*Clupea harengus*, Gunth.)

The PRESIDENT also read a communication from Mr. HURDIS, of Southampton, England, (*Cor. Memb.*), embracing his views upon revolving storms, particularly those of the North Atlantic. (*See Appendix.*)

ORDINARY MEETING, APRIL 13, 1868.

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

Dr. J. B. GILPIN read a paper "*On the Mammalia of Nova Scotia,*" being the fourth part of a series read before the Institute, and published in former numbers of the Transactions. (*See Transactions.*)

The author illustrated his paper with life-like drawings of each species.

The PRESIDENT alluded to the "slides" made by otters on the margins of lakes and streams, a fact mentioned by the doctor, and stated that he had seen such slides on the sloping margin of a lake frequented by otters at the base of the Blue Mountains, Shelburne Co.

Mr. W. C. SILVER stated that the otter, which was plentiful some thirty or forty years ago in the neighborhood of Halifax, was extremely scarce now, and might, indeed, be considered rare all over the Province.

Dr. Reid mentioned that the Skunk *(Mephitis chinga)* was very numerous in the Red River and Lake Winnipeg valleys, and in the vicinity of the town of Winnipeg. The Indians used it as food, and the camps smelt strongly of the animal, as the skins were hung about the wigwams, and the meat often boiling in the pots. He related an incident in connection with the habits of the Skunk, which took place at an encampment where he was staying. One of these animals, during night, came into the camp, and being suddenly surprised, voided its offensive fluid into one of the cooking pots in which was a mess of pork and beans ready for the next day's meal, which was thereby rendered uneatable, and he and his friends had to fast in consequence. The Indians did not consider the fluid poisonous. The skunk frequented the traps set for minks, and ate the bait. He had not observed the Raccoon in the Red River or Winnipeg districts, and thought its existence there was doubtful.

The President read a short paper "*On some of the rarer birds of Nova Scotia,*" giving notices of the occurrence of the Great American White Egret (*Ardea alba*), King Eider (*Anas spectabilis*), Curlew Sandpiper (*Tringa subarquata*), Pectoral Sandpiper (*T. pectoralis*), Schinzs Sandpiper (*T. Schinzi*), and others. (*See Transactions.*)

Dr. Reid remarked that from observations he had made in regard to the migration of birds in North America, he was inclined to believe that the birds arriving from the south in Spring followed the receding snow to the northward, and so worked their way up to their usual breeding places. He considered that currents of wind in mid-air, in which migratory birds were occasionally caught, conveyed them with a rapidity far greater than that of their usual flight, and instanced the case of a balloon voyage that had been made a few years ago between St. Louis, on the Mississippi, and Canada, when, although there was no gale on the surface of the country, the voyagers had been blown on a current at the rate of 60 miles an hour.

Mr. W. C. Silver had noticed, at the time of the autumnal migration, that at least three or four distinct species of birds intermixed and travelled in company.

Ordinary Meeting, May 11, 1868.

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

Mr. F. Allison read a paper entitled "*Meteorological Observations and Periodic Phenomena for* 1867." (*See Transactions.*)

The Rev. J. Ambrose read a paper, which was a continuation of his "*Observations on the Fishes of St. Margaret's Bay.*" (*See Transactions.*)

At the close of the proceedings, Dr. J. B. Gilpin moved a Resolution expressive of the regret of the members of the Institute generally at the departure from the Province of Mr. Andrew Downs, whose name as an ornithologist was not only familiar to all Nova Scotians, but likewise favorably known to science abroad. It was seconded by the President, who, in congratulating Mr. Downs upon his well-deserved and suitable appointment in the United States, expressed a hope, that although the Province and the Institute would greatly feel his loss, he would gain in his new home that respect and esteem to which his well-known talent as a naturalist, and his kindly disposition as a man, so well entitled him.

DONATIONS TO THE INSTITUTE.

SEPT. 1, 1867, TO AUG. 31, 1868.

The Provincial Legislature,.....$100 00

LIBRARY.

IN EXCHANGE.

Boston.—Boston Society of Natural History—Memoirs. Vol. I. Part 3.
" " " " Proceedings. Vol. XI., pp. 209-486.
" " " " Conditions and Doings of, 1867-8.
London.—Linnæan Society: Journal—Zoological Section. Vols. VII., VIII., IX. Vol. X., Parts 41, 42.
" " " Botanical Section. Vols. VII., VIII, IX., X.
" " " Proceedings 1866-7.
Montreal.—Canadian Naturalist. May 1867.
New York.—Lyceum of Natural History—Annals. April, May, 1867.
American Journal of Mining. Sept. to Dec. 1867—Jan. to Aug. 1868.
Philadelphia.—Franklin Institute—Journal. Sept. to Dec. 1867—Jan. to Aug. 1868.
Salem.—Essex Institute—Proceedings. Vol. V., Nos. 4, 5, 6, 7.
St. Louis.—Academy of Science—Transactions. Vol. II., 1861-8.
Toronto.—Canadian Journal. Sept., Dec., 1867.
" Canadian Entomologist. Vol. I., Nos. 1, 2.

LIST OF MEMBERS.

Date of Admission.		
1863.	June 24.	Almon, Hon. M. B., Hollis Street, Halifax.
1868.	Mar. 3.	Allison, Frederick.
1868.	Feb. 1.	Belmore, Dr., Staff.
1864.	April 3.	Bell, Joseph, Hollis Street, Halifax.
1863.	Jan. 8.	Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
1864.	Nov. 7.	Brown, C. E.
1864.	Mar. 1.	Campbell, W., Hollis Street, Halifax.
1867.	Oct. 3.	Cogswell, Dr. A. C., Hollis Street, Halifax.
1868.	Oct. 15.	Collins, Brenton, Gorsebrook, near Halifax.
1863.	May 13.	Cramp, Rev. J. M., D. D., *President of Acadia College*, Wolfville.
1866.	May 4.	DeMill, James, M. A., *Professor of Modern Languages*, Dalhousie College, Halifax.
1863.	Oct. 26.	DeWolf, James R., M. D., Edin., L. R. C. S. E., VICE-PRESIDENT.
1863.	Dec. 7.	Downs, Andrew, *Cor. Mem. Zool. Soc., London*, Central Park, New York.
1863,	Feb. 2.	Duvar, J. Hunter, Prince Edward Island.
1864.	Oct. 26.	Finnie, A. S., Bank of B. N. A., Halifax.
1865.	Oct. 4.	Fleming, Sandford, C. E., *Chief Engineer of Railways*, Halifax.
1866.	Feb. 1.	Forman, James, Thornfield, Halifax.
1868.	July 23.	Foord, A. S., Bank of B. N. A., Halifax.
1863.	Jan. 24.	Fraser, R. G., Spring Garden Road, Halifax.
1863.	Jan. 5.	Gilpin, J. Bernard, M. D., M. R. C. S., VICE-PRESIDENT, Barrington Street, Halifax.
1863.	June 15.	Gilpin, Rev. Canon, D. D., Halifax,
1863.	Feb. 2.	Gossip, William, Granville Street, Halifax, SECRETARY.
1868.	Mar. 3.	Grove, W., Halifax.
1863.	Jan. 26.	Haliburton, R. G., F. S. A., Halifax.
1863.	Oct. 26.	Hamilton, P. S., Granville Street, Halifax.
1863.	Jan. 26.	Hardy, Capt. R. A., Chatham, England.
1863.	June 27.	Hill, P. Carteret, D. C. L., Morris Street, Halifax.
1863.	Mar. 11.	How, Henry, D. C. L., *Professor of Chemistry, King's College*, Windsor.
1867.	April 1.	Jennings, Edward, M. D., Halifax.
1863.	Jan. 5.	Jones, J. Matthew, F. L. S., Halifax, PRESIDENT.
1866.	Feb. 1.	Kelly, John, *Deputy Commissioner of Mines*, Province Building, Halifax.
1864.	Oct. 12.	King, Capt. J. R., R. A., Artillery Park.
1867.	Jan. 7.	Knight, Thomas F., *Receiver General's Office*, Province Building, Halifax.

1864.	Mar. 7.	Lawson, George, Ph. D., LL.D., *Professor of Chemistry and Mineralogy*, Dalhousie College, Halifax.
1867.	Feb. 4.	L'Estrange, Capt. C., R. A., Artillery Park.
1865.	Nov. 9.	Lordly, E. J., George Street, Halifax.
1863.	Jan. 8.	Lyttleton, Capt. W., Hollis Street, Halifax.
1866.	Feb. 3.	Morrow, J. B., Brunswick Street, Halifax.
1865.	Nov. 17.	Nash, J. D., Dresden Row, Halifax.
1865.	Aug. 29.	NOVA SCOTIA, The Right Rev. Hibbert Binney, D.D., *Lord Bishop of*
1867.	April 1.	O'Brien, W. D., *Manager of Street Railways*, Halifax.
1867.	Mar. 1.	Outram, Joseph, junr., Bedford Row, Halifax.
1867.	Sept. 25.	Parker, Van Ess, M.D., Halifax.
1863.	Jan. 5.	Poole, Henry, Glace Bay Mines, Cape Breton.
1868.	Mar. 3.	Pottinger, D.
1866.	July 28.	Reeks, Henry, F.L.S., Manor Hall, Thruxton, Hampshire, England.
1866.	Jan. 8.	Rutherford, John, *Chief Inspector of Mines*, Province Building, Halifax.
1868.	Jan. 6.	Rule, Lieut. R. A., Artillery Park.
1864.	Mar. 7.	Silver, W. C., Queen Street, Halifax, TREASURER.
1868.	Oct. 14.	Scholfield, J.
1865.	Jan. 9.	Sinclair, Lieut. Col. R. B., A.G.M., Halifax.
1865.	April 20	Smithers, George, Granville Street, Halifax.
1868.	May. 7	Stockley, Capt. R.E., Halifax.
1867.	Aug. 16.	Tobin, Stephen, *Mayor of Halifax*, South Street.
1868.	Oct. 14.	Weeks, W. S., M.D., Dartmouth.
1864.	June 1.	Whytal, John, North West Arm, near Halifax.
1863.	April 15.	Willis, J. R., *Cor. Mem. Bost. Nat. His. Soc., et. Liverp. Micros. Soc.*
1866.	Mar. 18.	Young, Honble. William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct. 26.	Ambrose, Rev. John, M.A. The Rectory, St. Margaret's Bay.
1866.	Dec. 3.	Honeyman, Rev. D., F.G.S., Antigonishe.
1864.	July 1.	Marett, Elias, St. John's, Newfoundland.
1865.	Dec. 28.	Morton, Rev. John, Trinidad, West Indies.

CORRESPONDING MEMBERS.

1866.	Sept. 29.	Chevallier, Edgecumb, H. M. Naval Yard, Pembroke, England.
1866.	Feb. 5.	Hurdis, J. L., Lower Chamberlayne Place, Southampton, England.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

Art. I. Contributions to the Natural History of the Bermudas. By J. Matthew Jones, F.L.S.

(Read November 4, 1867.)

CORALLIARIA.

The Bermudas afford the naturalist an opportunity of speculating upon the effects of ocean currents, and the influence they possess in changing the character of an island group, to one almost distinct from that natural to it; because, if uninfluenced by the warm waters of the Gulf Stream, there is no doubt that the marine fauna of these islands would, in a great measure, coincide with that of the coast of Carolina, lying in the same latitude; but how different is the case. Here, in latitude 32° 15′ N., at a distance of about six hundred nautical miles from the American coast, lie a few little islands, begirt by coral reefs, which extend out to sea even to a distance of ten or twelve miles in some directions, and the various species of coral polyps raise their branched or massive forms, and thrive as luxuriantly, as if placed in their more congenial home within the heated waters of the tropics; while on that adjacent coast, they are unknown above latitude 26° N.; and this phenomenon is rendered still more remarkable when we take into consideration the fact of the Bermudas being the most northerly station

in the Atlantic at which the reef building polyps raise their structures. Dana, in his valuable work on coral reefs and islands, has shewn that the growth of coral reefs depends particularly on the temperature of the ocean, the character of coasts as regards depth of water, nature of the shores, presence of streams, and other conditions, especially liability of exposure to destructive agents.

Now, the Bermudas lying as they do on the outer or eastern edge of the Gulf Stream, are laved by its waters highly charged with animal life brought from the Caribbean Sea; and, as it is to the eastern edge of the stream that all drift matter inclines, so do the Bermudas gain no ordinary share of foreign forms, which are rarely, if ever, observed on the adjacent coast, even at a much lower latitude. These islands also, protected as they are from the influence of colder northerly currents by the vast body of heated water which flows past, present a fruitful field for marine organisms requiring an almost tropical heat for their perfect development; and thus it is that we find the reef building corals growing so well in an extreme northern latitude, where the temperature of the air during the months of January and February, sometimes falls as low as twenty degrees below the temperature of the ocean required for the growth of reef building corals.

This question regarding the proper temperature required for the development of reef corals, is still open for determination, for although 64° is named as the probable mean temperature of the seas in which such corals grow, it is by no means improbable that the shallow tidal pools, situate between tidal marks, on the shores of the Bermudas, which generally contain corals of the same species as those on the reefs, have the water they contain of a much lower temperature when cold northerly winds are blowing for two or three days in succession; reducing the air temperature so low that frost occasionally occurs, although very rarely, and ice has been observed the thickness of half a crown. It is also generally supposed that corals of the genera *Astræa* and *Mœandrina* grow better in the warmest waters; but on the Bermuda reefs members of these genera are met with of an amazing size, especially the well known "brainstone" (*Mœandrina cere-*

briformis). Again in the rock pools an astroid form *Siderastræa radians* is more common than any other, and appears to thrive well, although as before stated the temperature of the water of these tidal pools must be low at times.

The barrier reef forms a perfect belt all around the islands, running along the southern shore of the group at a distance of less than half a mile; while, on the northern shore it is distant some twelve miles. At the lowest tides this reef shows in places above the breakers, and presents a mass of corals, gorgonias, and sea weeds, with the exception of certain patches grown over and rendered imperishable by incrusting serpulæ and nullipores.

In regard to the growth of the Bermuda reefs I cannot acquiesce in the opinion of some naturalists, that all coral reefs require a very lengthened period to grow in. It is doubtless true that some species of polyps secrete their calcareous framework slowly, but there are others such as the *Millepora alcicornis* and *Oculina diffusa* which personal observation allows me to establish as instances of rapid growth, and as the Millepora in question is by far the most common form on the Bermuda reefs, and which in many parts are almost entirely composed of it, we may conclude that these barrier reefs at least, present an example of a more rapid development than is usually granted to such formations.

The reef building corals proper may be said to comprise eight species, yet there is another smaller form, *Mycedium fragile*, which is by no means uncommon, and contributes to the general mass, and on close investigation I have little doubt but that other minor forms may be found.

I am indebted to Professor Verrill, of Yale College, Newhaven, United States, for identifying several species.

Or. ZOANTHARIA.

Fam. ASTREIDÆ.

Gen. Isophyllia.

Isophyllia dipsacea, Dana.

This may be considered the most common coral on the reefs

and shores of the Bermudas, occurring in all places where the tide ebbs and flows. Cabinet specimens are easily obtained in the little tidal pools between high and low water mark; a long chisel and a mallet, enabling the collector to remove them without difficulty. Individual polyp cells may be obtained resting alone before becoming enlarged by the budding process, or masses of several adhering together. Large specimens are to be seen in about one and a half fathoms at the south-west corner of Harris's Bay at low water. This coral grows well in shoal water and is found within a foot of the surface. It is very common about the islands of the Great Sound, and also about Trunk Island in Harrington Sound.

Gen. Mæandrina.

Mœandrina cerebriformis, Lam.
Mœandrites costis latis, Gualt.
Madrepora labyrinthiformis, Linn.
" *mœandrites*, Pallas.
Lapis corallinus, Seba.
Platygyra cerebriformis, Ehren.
Diploria cerebriformis, Mil. Edw.

This beautiful coral which is known to collectors as the "brainstone" is common among the Bermuda reefs, growing to a very large size: sometimes three feet in diameter. Cabinet specimens of six inches diameter are more easy to collect, for it requires great leverage to detach the larger specimens from their foundations; without taking into consideration their weight, which is immense. Very large, perfect, and well cleaned specimens are highly appreciated in the English and Continental museums, few of which really possess fine examples of this coral. On breaking open a large specimen, the interior will be found to be tunnelled through in places by the *Lithophaga lithophagus*. It cannot be considered a shallow water species, for I have never observed it growing at a lesser depth than about four feet from the surface. Some fine specimens may be seen about the centre of Harris's Bay, and other parts of the

south shore within the barrier reef. In some instances the brainstone forms around the horny trunk of a *Gorgonia*, and I have a specimen in my collection thus attached to the palmate *G. flabellum*.

Gen. Siderastræa.

Siderastræa radians, Verrill.

This species exists in great abundance, and may be found in all positions, coating the reefs or shore rock, either in large masses, or just commencing a colony, with only a few polyp cells collected together, not larger on the surface than an inch diameter. It is an extremely beautiful coral when the calcareous mass, having been thoroughly cleaned, is viewed under a microscope of ordinary power, presenting a kind of tessellated star work. The mass is not thick, and in the case of small specimens I have collected, the coat does not exceed two-tenths of an inch. The polyp cells are irregular in form, some being circular, others oval, and in places prolonged cuts occur. It grows well in shallow water, and may be seen in the tidal pools within six inches of the surface.

Fam. Oculinidæ.

Gen. Oculina.

Oculina diffusa, Lam.

This elegant species is very common and may be found growing in large bushy masses on the reefs; but fine cabinet specimens may be obtained by searching about the small cavernous recesses about low water mark. It is known to the fishermen under the name of "star coral." It varies in form according to the position in which it grows; some specimens having the branches wider apart, while others present quite a

scrubby appearance. Although as a rule it is generally arborescent, yet I have examples in my collection where it has assumed the habit of incrustation both upon a piece of coal, and the neck of a common wine bottle. This character, however, is clearly exceptional, for it continues but for a short space ere it rises into the usual branched form. The polyps are in colour of a dull greenish hue, and the appearance of a specimen of this coral when fresh from its native element is anything but prepossessing; and it is only when properly cleaned and prepared for the cabinet that it presents the delicate and beautiful formation, which renders it so valuable in the estimation of collectors.

Oculina varicosa, Les.

This splendid coral is by no means common, at least not with the polyp cells highly protuberant. The finest specimens are obtained on the north reef, and sometimes the handsome *spondylus* is found adhering to their bases. When well cleaned and prepared for the cabinet I know of no more delicate and beautiful looking coral. It is very rare in collections. The branches of this species are much thicker and more separate than those of the preceding species, and are frequently entwined by the smaller *serpulæ*.

Oculina Valenciennesii, Edw.

This form is not common, and I have rarely found it in large masses. The mammiform nature of the polyp cells at once characterize it as a very marked variety from the two former species. In some cases the cells are also depressed, and even recedent, and these characters may be found combined on one stem. It tapers strongly from the base to the apex of the branches, which are unusually erect, and without lateral shoots until within a short distance of their apical terminations.

It is a fact perhaps worthy of note that these three species of Bermuda oculinas begin to decay at their bases as they grow

upwards. This condition probably arises from the attacks of parasites, for I invariably find all specimens more or less coated on the decayed parts with serpulæ, sponges, and minute marine forms. Milne Edwards gives Ceylon as a habitat for this species, so I presume it has a wide geographical range.

Fam. FUNGIDÆ.

Gen. Mycedium.

Mycedium fragile, Dana.
Leptoseris fragilis, Edw.

This delicate and pretty coral is not uncommon. It generally grows in thin plates, but occasionally assumes a cup form; and I have examples growing around the stems of other corals. It is found under overhanging rock on the reefs and on the shore about low water mark, and looks *in situ* like a fungus growing under a log. When viewed under the microscope it presents a series of frills, with polyp cells, situate along the line of frill. A specimen of this coral in my collection has one of the highest coloured spondyli growing upon it that I have ever seen. Major General Nelson, R.E., who was quartered at Bermuda several years ago, and is the author of a very valuable paper in the Transactions of the Geological Society of London, upon the formation of the group, aptly terms it the "pancake coral."

Fam. PORITIDÆ.

Gen. Porites.

Porites clavaria, Edw.
Madrepora porites, Pallas.
Porites conglomerata, Lam.

This species is well known to the fishermen as "rock coral." It is very common, and forms a considerable portion of the reefs.

Although usually arborescent in growth, it is nevertheless frequently seen coating the reef in large patches like the astroid corals. The thickness of the coat is about the same as that of *Siderastræ radians*. The polyp mass when *in situ* is of a brownish yellow colour. It grows well within eighteen inches of the surface at low water.

Fam. MILLEPORIDÆ.

Gen. Millepora.

Millepora alcicornis, Edw.
" *ramosa*, Id.
Madrepora palmata, Lam.
" *muricata*, var., Esper.
" *alces*, Dana.
Palmipora tuberculata, Duch.

This species is so various in its growth, that naturalists who have never had an opportunity of seeing it *in situ*, are prone to separate the different varieties, and class them as so many species. This is hardly to be wondered at, when we consider the very great dissimilarity which exists between the several varieties, as regards form of growth. It may be procured branched like the oculinas; flattened like a board; or coating the reef rocks; in fact, there is hardly a shape that it will not take according to the necessities of its situation. It is of rapid growth, and will in a short time coat over shells and firmly fix them in the coral mass; and it is curious to observe how these shells have managed to secure the right of opening one of their valves, which although perfectly covered with the coral, has, nevertheless, escaped having its opening closed by the calcareous secretion, and lives in this prison as well as if moored to the shore rock. It is known to the fishermen under the several names of "hen coral," when feathery in shape; "finger coral," when digitated; and "fan coral when flattened and palmate.

The following list of *Gorgoniæ* includes all the species at present known to inhabit the Bermuda waters :—

Or. ALCYONARIA.

Fam. GORGONIDÆ.

Gen. Gorgonia.

Gorgonia flabellum.

This species, known to the inhabitants as the "sea fan," is very common on the reefs, where it may be seen at low water waving its palmate fronds to the action of the surf. In form it is usually rounded, presenting a partially circular frame of network much compressed. Although it generally grows in one palmate frond, with a few small fronds sprouting out from, and at right angles with the main stem,—yet it is not uncommon to find specimens with several flabels growing from the same root; and on looking down into the clear waters of the 'Mudian shore this variety presents the appearance of a large cabbage with its leaves much expanded. The sea fan, when first taken from the water, is of a lovely dark purple, and although it fades if exposed to the sun's rays or too great a display of light, yet if kept in the shade, or in a darkened room, the purple remains for a long period. In Castle Harbour this species is abundant, and frequently does the boat of the collector brush through the bending plumes of this curious form as it passes over the raised coral patches which dot the shallow waters of that pretty land-locked bay. Small portions of this gorgon, when cleared of the external bark, are used by Bermudian cooks for skimming off impurities when boiling food, its sieve-like meshes acting as a strainer. These pieces are called "huskers."

Gen. Plexaura.

Plexaura crassa, Lamour.

The bark of this species on being dried becomes very friable, and falls off whenever the specimen is handled. The well-known "sea rods" which are made by the colored people, and sold for riding whips, are manufactured from the horny and flexible stems of this species, which are laced together and highly polished.

Plexaura flexuosa, Lx.

This handsome species which is named the "sea feather" or "prince's plume" from its resemblance *in situ* to a plume of feathers waving with the motion of the water, is not uncommon. The bark when the specimen is dried is much more tenacious than that of the latter species, as some examples which I have had in my collection for seven years are now as firm and fresh to all appearance, as they were when I collected them. It makes a good barometer, becoming moist before rainy weather, and dry when fine weather is to succeed. The footing which all the gorgoniœ have upon the reef rocks must be very firm, for the strain which takes place when the long branches are dashed about by the waves in stormy weather is enough to tear away every object off the reefs.

Gen. Pterogorgia.

Pterogorgia Americana, Ehr.

This species is found in the same situations as the latter. Its stems are more robust than those of the other species, and the root is generally very firmly fixed to the reef rock. The back in dried specimens becomes very friable.

Art. II. On the Food Fishes of Nova Scotia. No. VI. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read December*, 1867.)

The Shad.

Alosa Prestabilis, (DeKay.)
Alosa Tyrannus, (Gill from Latrobe.)
Alosa Vulgaris, (Storer.)

Description of a shad from the Shubenacadie river. One of four procured for the Paris Exposition, 1867, July 17, 1866 :—

Length of head, 3 6-10 inch.
Length to base of tail, 16 inches.
Breadth at deepest part, 5 inches.
From tip of nose to orbit, 9-10 inch.

The general outline. Head very small. The back rounding up suddenly from the opercles and making a bold convexity to dorsal fin, from thence descending to tail. The outline of belly very convex. A short thick fish. The upper jaw notched, the lower when open seemingly longer than upper, when closed of the same length. Colour, silvery from below to ridge of back, with a fine light reddish bronze catching about the sides. Top of back bluish ash, top of head greenish horn, sides of head and opercles yellowish and bronze with a few radiating striæ ; a row of spots of dark blue, commencing with one large one behind upper angle of opercle and extending along the sides to opposite posterior edge of dorsal fin—(when covered by scales these spots are not so distinct.) Dorsal and caudal fins bluish ash with dark extremities, ventral and anal light yellow. Pectoral light yellow, with dark upper edge. Rim of belly strongly serrated. Thirty-seven or eight points on edge of belly from gills to anus, some sharp, others worn down. No raised line of scales. Scales very large and irregularly circular. A large caudal pouch or scale, irides silvery, eye not filling up the orbit, nostril one-third nearer tip of nose than orbit. Toothless. Brangiostegal rays square pointed 7 of aside. D. 17, (counting the two first very short ones as rays), P. 17, V. 8, A. 17. Dorsal irregularly rhomboidal, caudal deeply cleft and much frayed and worn.

Weight above four pounds.

Nov. 14, 1868. Two shad were brought to Halifax fish market of this date. They were taken amongst some mackerel. In colour they were dark blue on the back, silvery on the sides, with none of that cupreous reflection in the summer specimens. The large humeral spot was scarcely to be distinguished, and instead of one line of small spots reaching only to posterior edge of dorsal, two lines of spots, each reaching nearly to tail, were present. The opercles and head were cupreous or bronzed and pointed with small black dots. The striæ on the opercle were much defined and in parallel and slanting lines. They were lean and out of condition The double row of spots is the more remarkable as they seem to be the typical mark of DeKay's species,—"Matawoaca." Being found so late in the season on our coast is a proof of their not migrating southward during winter, and I fancy of very rare occurrence.

Such is the description of this excellent fish as it appears in our waters about the middle of June, remaining about a month. They are seldom taken on the Atlantic coast, and never in quantities, but are brought to our market from the Avon and Shubenacadie. They are also taken in St. Mary's Bay, and in fact in all the bays terminating at ebb in muddy flats that flow into the Bay of Fundy. The Annapolis basin is seemingly too sandy for them, as they resort in much less numbers to it. According to DeKay, they appear at Charleston, S. C., in January, at Norfolk, Va., in February, New York, March or beginning of April, and Boston end of April. Perley says they appear in the Bay of Fundy middle of May and ascend the St. John river to spawn, and ascend the Miramichi river end of May,—their most northern limit. From this data he infers that the great body of fish perform an annual migration from the south to the north, returning in the fall. It is much more probable that the whole body winter in deep soundings parallel with the entire American coast, and as the waters of the Potomac, the Chesapeake, the Delaware, the Hudson, and the Connecticut, the St. John and the Miramichi are successively warmed by the returning spring, that portion opposite to each enter for the purpose of spawning, and return again to deep soundings. Otherwise one would have to suppose that of a body of shad near Charleston, all seized in January with the resistless instinct of reproduction, one part sought immediate and direct relief in the nearest rivers, the others made a long and laborious journey to waters then frozen stiff in ice—the rivers of New Brunswick and Nova Scotia. Such a supposition is untenable. From Perley we learn that they spawn in the lakes communicating with the St. John river in May, return immediately and resort to the mud flats at the head of the Bay of Fundy, to feed upon shrimps and a large worm called shad worm, found burrowing in the mud flats at the ebb-tide, and that this food gives them that exquisite flavour for which the Bay of Fundy shad are justly celebrated. No spawn is found in them at this season. From Messrs. Treat & Son, we find that their eggs spawned in June were hatched in three weeks, and in three months were able to seek the ocean. Frank Forrester affirms that their flesh is

much preferred to turbot by fastidious epicures. It has the quality of softness and melting in the mouth, different from the firm flakiness of the salmon or haddock. Coming to us by land, and during the salmon season, perhaps it has not that attention given it that its savouriness deserves. When salted it affords a geod item of export. In 1860, eight thousand barrels were exported. The exports of later years have not been returned separately from salmon in the blue book of Nova Scotia. As there are few or none on the Atlantic coast of the Province, I have not personally studied their habits, having only seen the drift fishing of the Avon. Here the boat, with one hundred or one hundred and fifty fathoms of seine payed out from its stern, drifts on the ebb and returns upon the flood, the seine held upon the surface by its head line of floats, being about three fathoms deep. The shad are picked out, meshed at intervals along the seine, which is twisted and knotted into a mass of apparently hopeless and impossible confusion. Father Gavreaux, priest missionary as he records himself, in a capital letter to Mr. Perley, 1850, gives a pleasant account of the shad fisheries among his French people, on the New Brunswick side of the bay of Fundy. He also states that the finest fish are taken at the end of the season, about the middle of September, and that in them, a blue band along the back represents the ordinary green or bluish green color. This is worthy of note as analogous with the same change in the gaspereaux, a smaller congener of the same family, upon which some naturalists have founded a new species. This letter is filled with numerous facts and remarks upon their food and habits, valuable as coming from an intelligent, educated and zealous man, and to quote his own words, "seen with mine own eyes, in my own boat, my St. Peter, when attending weir fishing for dog fish on the flood tide, and particularly enjoying myself at low water in catching the flirting shad inside the weir." This is language of an educated observer of nature, and is well understood by all who have had the privilege of loitering about and covering themselves with the mud and slime of a teeming stake net or weir. Convinced that fishing by weirs was destructive to the fish, and that drift fishing was more productive, this gentleman purchased

a boat of his own, with nets, worked her himself one season, and caught two barrels. To use his own language, "the experiment spoke well by my example and exertions; in three years twenty French boats followed me. In 1850, one hundred fishing boats were counted drifting down the Bay, all fine fast weatherly boats prepared for any storm." The usual amount of the catch of these French Acadians was 1500 bbls. Let us be thankful that there is an Acadie still left, where an educated gentlemen and a pious priest can take the oar and hook in his hand as well as the chalice and the cross, and doing both in the sole desire of his people's welfare, be thus followed and appreciated by them.

This fish was for a long time confounded with the English or Alice shad, *Harenga alosa* (Linn., Gunther), and is so given by Storer. DeKay gives to it the name, *Alosa Prestabilis*, taking Cuvier's new genus Alosa, and gives the distinctive marks from the Alice shad. Dr. Gill (Synopsis Fishes Bay of Fundy,) restores to it the name *alosa tyrannus*, from Latrobe, and in a note to me states his reasons for supposing Latrobe referred to shad by this specific. Dr. Gill's authority on American fishes will always command attention. In Gunther's catalogue (British Museum) there are no Atlantic specimens of shad, 1867. It only remains for me to mention these various opinions, and to lament the want of a good text book on the Atlantic fish brought down to the present day with all modern additions.

The Halibut.

Pleuronictes Hypoglossus, (Linn., Gunther.)
Hypoglossus Vulgaris, (Cuvier and Valencenes, DeKay, Storer)
Hypoglossus Americanus (Gill.)

In describing this large flat fish it is usual to consider it placed upon its lower edge with the tail towards the observer, and to call its sides right or left as they present. In this species the eyes are always on the right side, which is always dark brownish ash, and the left always white. Individuals rarely have been seen the reverse and with both sides dark. This description was taken from a specimen at the Halifax fish market, about two feet and a half long, weighing about twenty pounds.

The eyes both on the right side, irides silvery with bronze streaks, the right orbit smaller than the left, the eye itself apparently smaller, and raised above the orbit, being guarded by a skin on the upper edge like those in the frog, and nearly touching the intermaxillar bones forming the lips. The left orbit larger The left eye larger, and at least one diameter of orbit from the nose, and sunk deeper in the orbit. The nostrils double the second tubular, the right nearly midway between the orbit, the left in a line of posterior edge of left eye. The upper lip is divided by a deep sulcus from the nose, and is formed by the intermaxillar and maxillar bones, the maxillar fitting as in the cod into a groove. The lower lips are longer than the upper, with also a deep line passing around them ; both the upper and lower are fleshy. The line of pre-opercle is roundish, posterior edge of opercle commencing with a round turn, ends in a sharp point, the apex of which is opposite insertion of pectoral. The upper and lower jaws and opercles though differing in colour will be found on careful inspection symmetrical. The ventral fins inserted about their length from gills very small, six rayed. The left a little smaller than right. The pectoral fins small ovate, fifteen rays, counting the first short one, the third the longest, the right pectoral about one-fourth larger than the left. The dorsal fin commences in line with the left eye. The first twenty-four rays when closed fitting in a sulcus along the back. The rays each tipped with a soft point, commence small and gradually increase to a little beyond the half of the length of the fish, then diminish gradually, and end nearly at insertion of caudal. It contains about one hundred rays. The anal fin commences about double the length of the ventral fins from gills, and has the same general arrangement of rays as the dorsal, and ends opposite to it, having the same soft tips to each ray, which are about seventy-four in number. The caudal has seventeen and four short ones, and is crescent shaped The general shape of the fish is a long round angled rhomboid. The vent being in front of the insertion of anal, which is only double the length of the very small ventral from the gills ; it necessarily follows that the whole capacity for stomach and intestines, is scarcely a fifth of the whole fish. The upper or right side and part of the head and opercles are covered by scales so minute that they appear more like marks in the mucus thickly covering the skin ; a raised line of scales on the right side commences immediately behind the opercle, arches rapidly on the pectoral and runs straight to tail in a line with the vertebra, and on the left side there is a faint white line corresponding to it. In the upper jaw there is a double irregular row of large and small sharp pointed teeth, pointing downwards ; in the lower jaw a single row, in this and many other specimens, but from its irregularity I have no doubt that DeKay is right in giving a double row in the description of his. The colour of the right or upper side is dark brownish ash, of the lower pure white. That of the dorsal, anal caudal, right ventral and right pectoral is the same, but the left ventral and pectoral have both sides pure white. The lower or under edge of the jaw is covered with minute black dots. In saying the right eye protruded beyond the orbit more than the left, I meant it as studying the dead fish only ; but having noticed it so often I cannot forbear mentioning it In the living fish I have no doubt both eyes protrude like those of the frog, and are protected by a thickened coat of the sclerotic membrane.

Branch rays 6–7, D. 100, P. 15, V. 6, A. 75, C. 17½

In studying this fish we find as it were an ordinary fish,

highly compressed, then thrown upon its left side, and its mouth violently twisted to the right. Thus modified it becomes a bottom feeder, having no air bladder, perhaps never coming voluntarily to the surface. It must be confessed that the almost universal law of dual symmetry, is in part violated; but how little in so strange an alteration is a marvel to the observer. The ramus of either jaw is symmetrical, could we only twist it back again, the opercles are the same, there is even an attempt of a lateral line on the lower side. There is a slight difference in the size of the pectoral and ventral fins, relatively to each pair, the under ones being smaller. The right eye and orbit smaller than the left ones. From the lip thrown back and the twist of the mouth throwing the right eyes from the central spine, it makes the right optic nerve longer than the left. The optic nerves do not decausate, but join each other before entering the brain, which is exceedingly small and resembling a series of lobes. Indeed the spinal cord is smaller than one of the optic nerves. On turning the fish with its lower or white side up, and opening the abdomen, we find all the intestines very small, but holding the same position relatively to it as in other fish. The heart very small and tri-cornered. The liver lying in front of the stomach, light yellow and small, with a gall bladder on its upper edge. The stomach nearly circular, very muscular, and so reflected that with the intestines they resemble a double coil of rope, no air-bladder, one large cœcum, and large venous sinuses along the spine. The ovaries were tri-cornered, with a long ovaduct. The spleen was large. In observing the movements of the smaller flat fish, I noticed they were propelled by a series of contractions, commencing at the tail, (the term, fluttering, expresses my idea,) and passing through the body and dorsal and anal fins. Their motions are very quick, and doubtless this huge bottom feeder, attaining, in rare instances, six hundred weight, must thus range along the bottom of the deep soundings where he chiefly loves to dwell, his eyes protruding like a frog from the back, and his right side slightly elevated from the bottom, so as to strike the water obliquely. He must seize his living prey from below. The upward twist of his mouth coincides with this view. He must meet with few antagonists of equal power

amongst the hosts who people these many fathomed depths. Cod, haddock, pollock, hake, cusk or ling, herring, mackerel, cat fish, (*A. Lupus*) sea perch, (*C. Burgal*) and squid are found in his stomach. In fact every species that inhabit our seas. But we are less prepared for the various mollusks that are also found there. My friend Mr. J. R. Willis, so well known as a conchologist, has kindly given me a list of specimens, which he has at various times taken from their stomachs.* Many of these species must be in beds at the bottom of the ocean and must be torn or rooted from their attachments. We can only suppose there must be shelving banks and inequalities of the surface on whose sides the mollusks bed themselves, and that the halibut thus get beneath them in feeding upon them. Like all our fish they approach the land during the summer months and retire to the deep soundings during winter. They spawn in June, at least at that time the ovaries are the largest and the spawn escaping the most readily from the female when caught. Small fish of the size of the spread hand are taken both in our shore weirs and also on the banks, showing they spawn in both places. They are seen every month in our fish markets, but the best fishing season is in early spring, on the banks about ninety miles seaward, with sixty to eighty fathoms. The season commences the last of February or first of March; but the seas are too tempestuous and storms too violent for much to be done at so early a period. The meat when fresh is firm, white, and well flavored, either boiled or fried in cutlets, or spiced and baked. It does not take salt well. This is not much to be regretted on

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* NOTE.—The following I have taken from their stomachs frequently uninjured, apparently just swallowed whole, but sometimes affected by the gastric juice, or else in fragments.

Glycimeris, siliqua.
Astarte, castanea.
Cyprinus Islandicus.
Leda sapolita.
Pecten, Islandicus.
Natica, triseriata.
Lunatica, heros.
Fusus, decemcostatus.
Fusus Islandicus.
Fusus pygmaeus.

Occasionally I have found the remains of cephalopods, but too much injured by gastric juice to enable me to identify any of them with certainty.

Yours sincerely,
J. R. WILLIS.

the Atlantic coast, as it sells readily when fresh, its price often exceeding that of fresh mutton. The easier communication by steam with the neighbouring States has caused a large trade in fresh halibut preserved in iced boxes. At least £2000 worth are sent by steamers to Boston from Halifax during the season. All the American writers, with the exception of Gill, consider this fish identical with the European species. Gill by giving it the specific Americanus must consider it different. As its northern range is Greenland, it is most probable that commencing from a northern origin it has spread on both sides of the Atlantic.

With this large and curious member of the family of Planide I finish the Food fishes of Nova Scotia. The turning, so to speak, perpendicular into horizontal motion, the thin upright compressed fish into the broad flat one is effected so easily and so naturally, and with so slight a fracture of dual symmetry, that one wonders it has not attracted more attention, or that it has not been a fruitful theme for Darwinism. In these papers I have endeavoured to give all the facts at my command upon the food, the habits, the spawning time, and upon the minute exterior appearance and typical marks of the five families of Clupidæ, Gadidæ, Salmonidæ, Scomboidæ and Planide, which represent our food fish. I have at least made a beginning, though an imperfect one, being convinced that this is the only and proper way to approach the subject of our fisheries,—to determine whether they have declined or no, and the cause of that declension provided it is proved to exist. The question of food for at least the surface feeders,—how far its supply is modified by the winds and currents setting along the fishing grounds,—how far by the power of man,—must also be thoroughly studied. Many of these influences are doubtless beyond our controul; but the very knowledge of what is beyond our controul adds much to our capacity for holding and using what is within it. Many supposed facts, now reasoned upon as facts, must be entirely dropped, as for instance the Americans feeding the mackerel, and thus drawing them away from our shores. It would take the capacity of the *Great Eastern* and the national purse, to feed for one season the millions that swarm our seas. Another

that the bultow or set lines are destroying the fisheries. Bultow fishing only means that more fish are taken in a given time than by hand fishing. That in the inshore fishing, individuals do less than formerly, and also find more difficulty in obtaining bait, I believe to be true, simply because more men and boats and nets are employed, and thus the fisheries are divided. A narrow coast line becomes overfished, and bait become scarce in a limited range; but this ceases to be true on the limitless range of ocean banks. The returns of imported fish show a steady increase annually. Yet every individual shore fisherman will tell you, and doubtless sincerely, that it is decreasing, thinking only of his own small catch.

That fifty sail of American fishermen are at one time in some of our out-harbours purchasing bait; that many of them carry ice boxes, for preserving bait, to sea with them, are both significant facts of the scarcity of bait, and of what our coast fisheries must soon come to. With the exports of fresh fish, the fresh fish consumed at Halifax and in the Province, and the fish oils, we may put the annual value at about $4,000,000. This is large for a Province not enumerating 400,000 people. We may also state, that, as regards cod fishing, more than three-fourths of its value arises from coast fishing. That is, each individual hardy yeoman of the sea keeps his own rock hung cot, his boats, his net, and makes his own pile of fish, bringing it himself to market. The produce of this fishing is called shore caught, and commands a higher price than the Labrador catch, on account of the fish being brought to shore and cured immediately. The Labrador catch being pickled on board, and cured on the return of the voyage. It is manifest that it is in the interest of this class of fishermen, that legislation, if at all, should be obtained, that ice houses to preserve bait should be encouraged, perhaps by small grants, and perhaps some prohibitory laws, against exporting fish bait, though it must be confessed that all prohibitory legislation is of doubtful benefit, and when not founded on exact knowledge of facts often acts injuriously. That there is a growing deficiency of bait, and hence of fish following that bait to the shore, I think, must be admitted, though much exaggerated by the fishermen themselves. If this can be

remedied by any means, then the coast fishing will return; if partially remedied then the coast fisheries will only be retarded in their gradual absorption into ocean and bank fishing. The single men, who now each in his own boat takes his own fish, must club into tens, build fishing smacks, and commence ocean fishing. That is to say, capital must come to assist labour. That more fish will be produeed, it is probable, but the individual fisherman will suffer. From being a yeoman of the sea, and owning his own boat, he will become the servant of the capitalist—or the man who puts the most value in the joint stock. For one, I would be sorry to see the Nova Scotian fisherman reduced to the Newfoundland fisherman. The presence of capital has the great and good effect of tiding over temporary scarcities. It always has its accumulations. But one who is familiar with the half-dozen fishing villages, hanging up as it were on the rocks of our out-harbors, with their tidy kitchens, and neat bed rooms, their well fed children, and well clothed men, their neat boats and nets, and compares it with the state of the oppidan laborer, mechanic or truckman, living usually in one or two rooms of an evil smelling house in a dingy street, must look with concern at any causes that are slowly causing them to pass away.

Art. III. Notes on the Economic Mineralogy of Nova Scotia. By Prof. How, D. C. L., *University of King's College, Windsor, N. S.* Part IV. Gypsum and Anhydrite and the Borates and other Minerals they contain.

(Read November 4th, 1867.)

In the present paper I propose to consider the immense deposits of gypsum and anhydrite which have long been of great economic importance to the Province, and the minerals found in them, some of which, being useful, will add much to the value of the plaster quarries, if abundant. The term plaster, just used, being employed locally as the name both of gypsum and anhydrite, I shall avail myself of it occasionally as convenient, and may mention that gypsum is sulphate of lime with

water, while anhydrite is merely sulphate of lime. These substances are found here in quantity, exclusively in the lower carboniferous rocks in close association with the lime-stones described in the last part of these "Notes," (Trans. N. S. Inst., 1866.) In small amount fibrous gypsum and selenite are found in new red sandstone and trap. The beds of plaster are often of great thickness; a few miles from Windsor lofty white cliffs of it are seen on the road to Newport, and many fine exposures are mentioned in "Acadian Geology." Although comparatively few of the deposits have been worked to any extent, a great deal of plaster has been quarried. The following tables convey much valuable information; it appears from the last census returns that the amount of gypsum quarried was, in 1850, 79,795 tons, and in 1860, 126,400 tons: the return for the latter year shews that it was quarried in eleven out of the eighteen counties in the following quantities and gives its value:—

Gypsum quarried in Nova Scotia in 1860.

Counties.	Tons.	Value in Dollars.
Colchester,	6026	5407
Kings,	0	0
Cumberland,	259	206
Annapolis,	0	0
Pictou,	70	46
Hants,	118215	77883
Antigonish,	10	10
Inverness,	12	21
Halifax,	58	53
Lunenburg,	300	120
Yarmouth,	0	0
Digby,	0	0
Guysboro',	250	190
Victoria,	0	0
Queens,	0	0
Shelburne,	0	0
Richmond,	1470	1226
Cape Breton,	30	24
Total,	126700	85,186

No census having been taken since 1861 we have official details only with regard to exportation, and I have made out from the Trade Returns the following table, showing the

Quantity and Value of Gypsum Exported from Nova Scotia in years ending 30th September.

Year.	Tons of 2240 lb.	Value in Dollars.
1854	87283	74935
1855	95301	80875
1856	72210	61485
1857 (Windsor only, 9 months,)	33862	11050
1858 (Estimated amount,)	86291	69015
1859 " "	109243	87395
1860	105431	85936
1861 (Estimated amount,)	51013	40811
1862 " "	38031	30425
1863	46739	30625
1864	58601	43167
1865	56155	45088
1866	77091	63611
1867	103426	88486
Totals	1020677	812904

From the first of the foregoing tables it is obvious that Hants was in 1860 the chief gypsum raising county, it is so still and Windsor is its principal port of shipment. In fact by far the largest quantity of the rock is quarried at Windsor or in its neighbourhood, where operations have been carried on some eighty or ninety years, and from 1833 to 1867 there were exported from Windsor not less than 1,404,376 tons of 2240 lb., of the value of 1,031,154 dollars. During the late American War the trade was much depressed, last year, however, it had to a great extent revived, and there were

Exported from the County of Hants, N. S., of Gypsum, from Jan. 1st to Dec. 31st, 1867, from the following

Ports.	Tons of 2240 lb.	Value in Dollars.
Hantsport	9420	9112
Maitland (9 months)	2440	1708
Walton	9845	7384
Cheverie (chiefly hard plaster)	14799	8190
Windsor	63655	54106
Total	100159	80500

As regards Windsor the quantity just given has never been exceeded by a year's exportation; the price of gypsum here is on the average 90 cents a ton, shipped, at other places in the province the value is different from various causes. On the

Grand River in Western Canada, the only locality in old Canada where workable deposits exist, the price is about $2 per ton at the mine. The thickest bed there is about 7 feet only and the amount annually raised was given in 1863 as 14000 tons. (Geol. Canada, 763.)

The produce of several quarries within a few miles of Windsor are brought here for shipment. In this district the quarries are worked on parallel beds running E. and W., the most northerly extending from Windsor through Wentworth and Newport probably as far as Shubenacadie some 30 miles to the east, where plaster is also worked. The distance across the strike from the north at Windsor to the most southerly quarries is about three miles: at Windsor the dip is gently to the south. The largest quantity of plaster is raised in the Clifton Quarry, the property of Mr. Pellow, close to the town of Windsor, where operations have been carried on about forty years. The principal rock is gypsum, the anhydrite or hard plaster, is found in lenticular masses from 2 to 10 feet thick in the centre and sometimes 50 feet long, imbedded in the soft plaster. Mr. Pellow considers that the amount quarried here has varied for the last thirty years from 10,000 to 30,000 tons per annum and for the last ten or twelve years from 20,000 to 30,000 tons. The quarry is roughly estimated to be 800 feet long, 180 broad, and 40 deep. The rock cropped out near the surface at the north side and on the south side a face of about 30 feet plaster with a little limestone here and there is to be seen. Operations in depth can now only be carried on by aid of pumps, and a steam pump has lately been erected.

On another range to the south are extensive quarries, owned respectively by Messrs. Wilkins, M'Letchey and Pellow, about 1¼ mile from Windsor. The rock found here is of good quality, a face of from 15 to 40 feet can be got, and the beds have been traced across the strike for 300 feet. It is estimated that much more than 100,000 tons have been extracted.

On the last range south are the quarries of Mr. Black, south of these are the metamorphic rocks of the Ardoise Hills. From the Wentworth quarries about two miles from Windsor some 40,000 tons have been raised during the last two years. The

great distinction made in the qualities of gypsum is between blue and white plaster. The former is chiefly used for agricultural purposes, probably the greater part of that exported is so employed; it is sent to Boston, New York, Philadelphia, Richmond and Baltimore. The chief consumption I understand to be in Virginia, Maryland and Pennsylvania, where the ground plaster is used as manure for tobacco and Indian corn; before the late war gypsum was becoming a favourite fertilizer in cotton growing and large orders were sent, but the war interfered, and as yet, trials have not, I believe, been further made as regards this application. The white gypsum is sought for boiling and burning by which it is prepared for the making of plaster for walls, ceilings, cornices, etc. Gypsum consists of—

Lime,	32.55
Sulphuric acid,	46.51
Water,	20.94
	100.00

and its property of furnishing plaster depends on the fact that its water can be expelled and afterwards taken up again. Calcined gypsum is what remains after burning or boiling; the burning is effected by building up lumps of the rock into heaps with cord-word intermixed and maintaining a very moderate fire for some hours, the burnt plaster is afterwards beaten to powder and is fit for use: in boiling, the ground gypsum is heated in caldrons and the peculiar agitation caused by the escape of water is so like that of a liquid in ebullition that the plaster is said to boil. The burnt or boiled gypsum is mixed with water to a paste and when left it soon hardens. The best plaster, that which sets most quickly into a hard mass, is got by heating to about 500° Fah., if the heat attains redness, the gypsum becomes very dense and does not set with water. Most important properties are gained by the addition of one or two per cent. of certain salts, such as borax and sulphate of potass. Gypsum which has been thus treated will endure a red heat without losing its power of setting with water; it becomes much more dense than common plaster, sets in a few hours, becomes hard and takes a fine polish. Keene's, Martin's and Keating's

cements are the names under which such plasters are known. Stucco is coloured plaster mixed with size. (Miller's Chemistry, II. 801). If gypsum is mixed with a certain amount of water and soaked in hot pitch it parts with water and takes up pitch and forms a substance so hard and susceptible of polish that it could be employed in making a variety of useful and ornamental articles. Although the foregoing cements or most of them are well known and much valued, it is said by a recent observer that with one exception all admixtures impair the hardness of plaster. The exception is iron filings. When these are mixed with plaster they rapidly oxidise, and the coherent mass of oxide of iron formed adds its own strength to that of the plaster making a very firm material which has also the advantage of uniting itself to surfaces of iron: it is supposed that the filings should form about one-fifth of the whole weight to give the best result. (Chem. News, No. 436, p. 182). It is obvious that the manufacture of such substances as those mentioned could be carried on here with the greatest possible advantage, the quantity of gypsum being perfectly inexhaustible, and the varieties numerous.

Of these varieties the "isinglass" of the quarrymen, selenite of mineralogists is the purest. It is colourless and transparent as flint-glass: it is abundant in some quarries. It has been used in filling fire-proof safes. It cannot be used in place of mica, with which it is often confounded under the incorrect name of talc, in stove doors, etc., as it becomes opaque in the heat. Fibrous gypsum is found in veins, it affords very white plaster as well as the foregoing. Compact white opaque gypsum, called alabaster, is met with at Antigonish and also near Windsor at Three Mile Plains and in Falmouth. That from Antigonish is suitable for carved work as was shewn by a small piece of work, executed by the late C. Harding, Esq., of Windsor, sent to the Dublin and Paris Exhibitions: some remarks on the durability of this material and the propriety of having illustrations in the Provincial Museum will be found in the last Part of these Notes. (Trans. N. S. Inst., 1866). Between the other varieties of gypsum there is a difference in composition from the admixture of variable amounts of oxide of iron, carbonates of

lime and magnesia, and other ingredients do not interfere with their use as manure, but prevent their affording the best plaster. An opinion prevails that "rotten plaster" or that which has been exposed to the weather and crumbled down has lost its "strength". I analysed such a gypsum from the property of O. King, Esq., of Windsor, and found it to contain—

Water and trace of carbonic acid,	21.16
Lime,	33.02
Sulphuric Acid,	45.99
	100.17

or almost exactly the quantities of ingredients proper to pure gypsum: hence the rock was entirely unchanged, chemically, by exposure, and fit for all the purposes to which it can be applied. Unweathered gypsum varies very much in hardness but is never so hard as anhydrite, which is called from obvious property, "hard plaster."

Anhydrite is composed of—

Lime,	41.18
Sulphuric acid,	58.82
	100.00

it is of various colours, as dark blue, grey, and purple; exposed to the weather it becomes white with a peculiarly rough surface, hence it is often called in this condition "sharkstone." It varies much in hardness, some samples give a clear sharp sound under the hammer, others sound dull; hard plaster is often a mixture of anhydrite and gypsum, and affords some water on being heated. It is used at Windsor as a building stone for the foundations of houses, and walls to support fences. It makes apparently a good substitute for marble in in-door work; a small table-top and a pedestal were made and polished at Windsor, by Mr. Wood, and shewn at the last Paris Exhibition; the latter especially was much admired at the preliminary Exhibition in Halifax. How long the beauty of surface will be retained remains to be seen; since blocks of almost any useful dimensions can be obtained a trial of its qualities is well worth making, and a very suitable place for the experiment is the

Provincial Museum. Anhydrite does not admit of use as plaster by burning or boiling but is equally good with gypsum for agricultural purposes, in fact it is about 21 per cent. more valuable so far as its ingredients are of use as it is free from water. It is not ground in mills but crushed by stampers. The rock from Cheverie is chiefly anhydrite, it goes mostly to Bridgeport, near New York, where it is almost the only kind employed. It is valued at Cheverie at 55 cents a ton.

Minerals contained in Gypsum and Anhydrite.

In the deposits just described no attention has been given practically to foreign minerals, indeed no considerable amount of these has been found; but small quantities of various kinds have been met with which are very interesting from a scientific point of view, and some of these will prove very valuable if abundant. What the quarrymen call "salts" is said to be often found, especially at the line of junction of hard and soft plaster, where there is often a narrow seam partly filled with it. It is described as having strong purgative properties, and as "salts" is the common name for sulphate of magnesia, I once thought it might be the substance found, but I have never seen this here, while Glauber-salt or sulphate of soda has been brought me more than once as found in the Clifton quarry: it is said to be plentiful occasionally. I have also had common salt brought from the same quarry in small quantity.

Borates. The most important minerals of possible future value are certain borates, the first of which made known as occurring in the gypsum, was described by myself about ten years ago; I have since found two others which are quite new and peculiar to this province. The first mineral was brought me by one of our students, and I shewed it to be natroborocalcite, which at that time had only been found in Peru, where it is called Tiza, and perhaps in Tuscany, and which I had seen imported to Scotland from the former country: I found it to contain when washed free from a little sulphate of soda:—

Soda,	7.21
Lime,	14.20
Water,	34.49
Boracic Acid,	[44.10]
	100.00

Soon after I had sent an account of the discovery of the mineral here to a Nova Scotian newspaper, I received a letter from Mr. George Outrim, Stoke-upon-Trent, Staffordshire Potteries, in which he made inquiries to which I replied, and a correspondence ensued, the nature of which will appear from a few abridged extracts from Mr. Outrim's letters. "June 16th, 1857.—I take the liberty to ask what this mineral is, as I see it contains boracic acid to the amount of 40 per cent. As this district, the seat of the pottery trade, is by far the largest consumer of this article either as an acid or as borax, and as its present price makes it an exceedingly heavy article in our trade, any prospect of an additional source will be looked to with anxious interest. I presume it is a borate of lime, if so, it would not be so valuable for our purpose, but if the acid could be separated, or it could be converted into borax on the spot, it would be doubtless very valuable; if the supply should prove abundant it would be a great pity that so rare a substance should rest unused." "Sept. 21st, 1857.—Your mineral contains nearly the same amount of acid as a specimen of the same in my possession from South America. There has latterly been a large importation of borates into this district, and more of the manufacturers have been induced to use it in this state, so that, although in the state of borax it is more generally used, it can be now pretty readily sold in the state of borate of lime. Of course it is not so valuable in this latter condition, and the current price in this market has lately been such that it should be delivered in Liverpool free of charges at about £20. May I ask you to send me about an ounce to make such a trial of it as will enable me to judge if it be suitable for pottery." The late discoveries of borax in California must have materially altered the value of borates if the company working them can "place borax in London cheaper than it

can be made there, which, at the lowest estimate is five cents a pound." (J. Ross Browne on Resources of States West of Rocky Mountains, 1866, p. 187). However this may be, the borate found here is itself valuable as a glaze, as seen from the next letter of Mr. Outrim's. "Nov. 23rd, 1857.—I have just put a portion of your mineral through the tests usually employed here, and I have the pleasure to enclose you a small bit of pitcher to which the borate has been applied as glaze, and, as you will see, the result is really very good; the borate was applied alone and simply passed through the potter's oven in the usual way—of course the glazes in ordinary use, being composed of various other ingredients, possess more evenness and opacity, but the fact that your borate will of itself produce such a glaze speaks strongly in favour of its quality. In short, it is as good as any I have seen of the same mineral."

A short time ago I observed in a heap of gypsum, consisting of about 300 tons, from the quarry of Mr. Black, at Brookville, about 3 miles south of Windsor, the first that had been taken out for some twenty years, a considerable intermixture of the borate just spoken of. Scarcely a stone of a particular sort was free from it, and in some specimens, in a few square inches of surface, several lumps were present. Sometimes lumps the size of hens' eggs were readily detached. I have found this borate also in plaster from Newport, and from accounts received it probably has been met with elsewhere.

The second borate found here was in very small amount, but it bore sufficient resemblance to the first to leave no doubt that it could be used for the same purpose. It is described (Edin. Phil. Journ. and Silliman's Journ., 1861,) under the name of cryptomorphite.

The third borate, just discovered, is a most interesting addition to known mineral species as there is only one other mineral which resembles it in chemical constituents, namely datholite, which also contains water, lime, silica and boracic acid, the proportions, however, are very different. I am about publishing an account of the new species under the name of silicoboro-

calcite* in my "Contributions to the Mineralogy of N. S.," in the "L. E. D. Phil. Magazine," and only name it here in connection with economic minerals because it contains almost exactly the same amount of boracic acid as natroborocalcite, and like it would no doubt give a good pottery glaze. I think it would also be found specially adapted for glazing iron vessels, as I find a borosilicate of soda is now preferred to silicate of lead for this purpose, as not affording lead in culinary operations to the contents of vessels so glazed. I found on analysis of the mineral:—

Water,	11.62
Lime,	28.04
Sulphuric acid,	80
Magnesia,	trace
Silica,	15.44
Boracic acid,	[44.10]
	100.00

Salt from Brine Springs. Although no deposit of rock salt of any importance has yet been found with gypsum, the brines of the gypsiferous districts, of which some account will be found in a former paper of mine, (Trans. N. S. Inst., 1865,) have furnished excellent salt at R. Philip, at Springhill, and Pictou, and a company is now making salt at Antigonish.

Art. IV. Magnetism and its Connection with the Telegraph. By Thos. R. Fraser, M. D.

(*Read January* 6, 1868.)

The object of this paper will be to give the philosophy and practical working of the *Magnetic* Telegraph. The term magnetic is chosen in preference to electric, as commonly used, Magnetism being the *primary* power or force which causes the magnetic action. Electricity being *merely an effect* of that

*Since this paper was written, Prof. Dana, to whom I sent specimens of the borates mentioned, has, in the new edition of his 'Mineralogy,' given the name of ulesite to natroborocalcite, retained the name of cryptomorphite, and given the name howlite to the new species here called silicoborocalcite.

power, when under certain conditions. True there is connected with the telegraph a mechanical power and action as well, but this is only from a secondary agency employed in its operations. The combination of these two powers, magnetic and mechanical, in the telegraph, may remind one of the action of the two powers we notice in the animal organization, distinguished as involuntary and voluntary. So close is the resemblance that we may without impropriety term the magnetic telegraph an artificial animal.

It will be necessary for the sake of clearness to distinguish between the two agencies, the magnetic and mechanical, for although they work in harmony they are nevertheless totally different in their modes of action, being *governed by different laws*. The mechanical or voluntary agency is well known, and is apparent only in visible matter and through *mathematical* rules. It controls all voluntary and *secondary* forces and motions. But these forces and motions are induced *primarily* by the involuntary power inherent in *all* matter, which power is under the control of *natural law only*. And this law may be observed in the action of all atoms visible and invisible, in *all chemical* and natural phenomena. It is only influenced by mechanical law through mechanical arrangement of matter, or in other words when matter is placed in a position by which its atoms may be free to act through their magnetic forces and natural properties. The magnetic or primary being a subtle invisible agency and force, can only be known as to its nature by observing its action and law on matter in its various forms, circumstances and positions. To this agency belongs what may be termed the primary force and involuntary actions of the telegraph.

Magnetism, or that primary force noticed in metals, and its law, is the invisible controlling agent or power in all matter or atoms, in either their gaseous, liquid, or solid forms. Concerning this power, its law and action, there has been many conjectures, particularly in reference to the nature and operation of electricity and magnetism in the telegraph and in animals. We have as yet had no certain theory of either, and most persons consider such subjects too mysterious even for enquiry.

I will now give a few opinions from late writings of Professors who have made electricity their study, and then submit an opinion of my own. Dr. E. L. Youmans, in a work published in 1865—"The Co-relation and Conservation of Forces, a series of expositions, by Prof. Grove, Prof. Helmholtz, Dr. Mayer, Dr. Faraday, Prof. Liebeg and Dr. Carpenter," has an article on Electricity, and says, "From the manner in which the peculiar force called Electricity is *seemingly* transmitted through certain bodies such as metallic wires, the term *current* is commonly used to denote its *apparent* progress. *It is very difficult to present to the mind any theory* which will give it a definite conception of its *modus agendi*." On Magnetism he says, "*It is difficult* to convey a definite notion of the force of Magnetism, and of the mode in which it affects other forces."

"*Good Words*" for January, 1867, has a paper from Professor Thompson "On the Atlantic Telegraph." He says, "It may be regarded as *probable*, that there is a real electric fluid, and that this fluid really flows through the wire, *but in the present state of Electric Science we cannot tell*, or even conjecture on any grounds of possibility, whether the true, positive Electricity is that which is commonly so called, or whether it may not be, on the contrary, that which is carried by the oxygen to the zinc."

An article in the Jan'y No. of Eclec. Med. Review (1867,) "On Electrotysis of Metals," says: "As the velocity of the battery is a source of mystery to some persons, the following may not be irrevelvent, &c. " * * * Here it is supposed that electricity derives its origin, or, at least, its dynamic force, *from the decomposition of water*."

From the first that was noticed of electricity and magnetism by our savans to the present time, there appears to have been nothing more than an accumulation of facts. *From that* I can find no definite opinion either of its origin, operation or nature, further than this, that magnetism is an invisible power, the effects of which are more particularly noticed in steel, under certain conditions, as magnets, and generally supposed to be confined to metals only. There is exhibited throughout all the constituent parts of our material world an invisible power or

force commonly called "electricity." The *effects* of that force are seen in the atmosphere and in connection with the dissolving and reforming of substances, in animals and in vegetables, and more particularly in connection with metals. From a close examination of the observations and experiments of others, together with those of my own, I propose to state what I believe to be the *nature and action* of that force, or of *magnetism*, and its application to, and operation on telegraph lines and submarine cables. I find in *all atoms* an inherent power (an atomic power), more "or" (and) less in *all* matter, which power is brought into action *only* when the atoms are under certain conditions, which power is similar to that noticed in steel, and *there called magnetism.* All atoms *can* be arranged into *two separate classes*—"mineral" and "vegetable." These classes of atoms have properties in common, and also *dissimilar* properties. When these two classes of atoms are in the form of gases or liquid, and come into contact, their atomic *power* is brought into action, by which power each class attracts *its like*, causing a *reciprocal* action, which, in combination with the *dissimilar* properties of these classes of produce what is commonly known as *chemical action.* This action cannot be produced without the agency of the *two* classes of atoms, and then only when they are presented under certain conditions. In solids the magnetic or atomic power of those atoms are brought into action through the agency of water, which holds both classes in solution. When the two classes of atoms are in an "insulated" position *in the atmosphere*, and then under certain conditions, their action *produces* and exhibits what is called "*Electricity*." Thus the force *producing* electricity as exhibited by a telegraph line, is *caused* by that atomic, natural, magnetic, reciprocal, *chemical action*, in the battery, decomposing the metals and the acid, *through the agency of water*, which force and action *converts the line into a magnet*, at the will of the operator, and only conditionally exhibits electricity. There is *no electric* current *except at the poles*, and there only when they are in juxta position, and where that action is insulated from the earth. I will now explain the *cause* of that involuntary atomic action by its natural law in the battery producing mag-

nets and electricity on a telegraph line, and how that magnetic involuntary action harmonises with the voluntary or mechanical agency of the operator, exhibiting life or motion in the line, and showing the necessity for the combination of the two powers (similar to those in an animal) for the effectual working of the telegraph.

The first action is in the solution of acid and water, while preparing them for the battery; that *action* is *caused* by the acid having an excess of mineral and the water an excess of vegetable atoms in solution; when they are placed in contact, each *attracts its like* material; and their reciprocal action continues until their particles are equally distributed. Place the ends of a piece of zinc and a piece of copper in this solution, a similar reciprocal action is produced between the metals and the solution. The solution having the excess of vegetable atoms acts upon each piece of metal *separately*. If the upper ends of those pieces of metal are brought into contact, the action is increased at the lower ends, as poles, by the two pieces now forming *one* magnet, and *its poles reciprocating* through the solution. There is no action or current exhibited at their junction or middle. Any number of cups of the solution with similar pieces of metal alternately connected to form a battery, will thus be acted upon separately while they are disconnected. If connected or brought into contact through any moist or metallic substance of *any* length as a telegraph line, the metals will all act together as one magnet; the force of their union may be noticed in the battery by its increased decomposing action, and in the line by the greater power of *its* magnets, when the line is in a position to exhibit its polarity, but not otherwise. All the requirements for telegraphing with this line are a "relay" and "key." The relay is a piece of soft iron in "horse shoe" form, covered with a small wire coated, the ends of which are connected in the line. The ends of the iron of the relay forming the poles of the magnet, exhibit the force of the line from the battery by attracting another piece of soft iron called an armature. The key is an instrument attached to the line for the purpose of *breaking the line*, by the will of the operator; when the line is thus broken the force is thrown off

it and into each piece of metal in the battery as described; when the line is connected *by the key*, the force is then in the line, and is shown in the relay magnets by their attracting the armature. Thus the *motion* of the armature made by the key of the operator, can be read at the same time by any number of operators on any length of line, at any number of stations having similar arrangements. If a person on the moist earth take the uncovered line in his hand, or place the wire of the line to his tongue, he will be able to read the action of the operators on the line by reason of his connection with the earth. If he form a close connection between the line and the earth, no force can pass him on the line, as the force is absorbed through him by the earth, which forms a solid connection. If he is insulated from the earth and in contact with the line, he will find *no effect* from the line unless it be broken and each end in his hand, his body then forming a part of the line as a "conductor." *No current* passes through him or through the line, but he feels the sensation and action *from the poles* at the point of contact only, and the Force is received in his body as in a magnet. *That action on him is* GALVANISM, and is a *result* or consequence of the action in the battery from the poles of its magnet, or the *ends* of the line. If those wire ends or poles are brought into contact by a fine point or *fine* wire that will concentrate their force, *their* reciprocal action will exhibit a spark of *fire*. *That spark is* ELECTRICITY, and may be elicited under certain conditions in *all* cases of "decomposition." We may thus see *electricity* to be merely an exhibition or an effect of that force or power in atoms, or where reciprocally acting when insulated from the earth; and *galvanism* to be the effect of an application of the atomic or "magnetic" power and action in metals to a living animal, *causing* an increased life motion, and when applied to a dead animal an artificial or induced life motion. There is, therefore, no *current* that passes through or over the telegraph line, nor yet can there be a "return current," through the earth, (as is supposed.) The earth being a solid moist mineral body, a *battery* and magnet of itself, receives and absorbs the force from the line at its junction. Hence I find the involuntary natural agent causing the action of the telegraph line,

to be that atomic "magnetic" power in the battery which produces magnets at the will of the operator, by his voluntary mechanical agency; and that *magnetism* is the primary power and action through which the line operates. Electricity being merely a conditional effect of the polar reciprocal action of the magnets, both poles being positive, under different conditions, and not one positive and the other negative, as is generally supposed, all that is required of a telegraph line is that its wire be "solid" in length, and thoroughly insulated from the moist earth, as the present Atlantic cables appear to be. Yet a telegraph cable that will gradually lose the iron may thus be of less weight and dimensions where the water deepens, and can still have these two properties; it would thus avoid all the difficulties met with in the frequent attempts to lay the Atlantic cables, that were finally surmounted by strictly *mechanical force*, in preference to their being avoided by an examination of the *natural* law and force of the material, and applying that law to those lines before attempting to lay them. The operation of which *law* on such material, I am now prepared to illustrate and explain to you by experiment, for your observation.

Art. V. Oyster Culture in France. By T. F. Knight.

(Read February 3, 1868.)

In the application of science to industry France has long afforded a distinguished example, partly through the scientific genius of the nation, and partly through the encouragement which is given to scientific progress by the French government; and in no branch of scientific industry has she more excelled than in the art of Pisciculture. In France, it is well known, the first successful experiments were made to revive the ancient practice of breeding fish from the ova taken from the living animal; so that by a process of cultivation, from small beginnings, so greatly did the art of artificial propagation succeed, that valuable fisheries that had declined, were restored to fertility, and new localities were stocked with young, that soon teemed with the fruits of natural increase.

But science has been equally successful applied to the propagation of the most valuable of the edible mollusca—the oyster, (*ostrea edulis*,) and at the present day oyster fields present as busy an aspect, and are as skilfully managed, as a well cultivated farm. The activity visible in one of the basins or bays where oyster cultivation is most extensively carried on, is thus described: "On all sides, the oyster banks exposed at low tide, and the *pontons* dry; over the parks, the oystermen may be seen, with their wives and their children, covering these domains, resembling groups of gleaners in a field. In reality, the cultivation of oysters bears a close analogy to that of the soil. A knowledge of the most suitable soil, its preparation, the seed from the mother oysters, their distribution over other grounds, the destruction of enemies which have the power to injure them, establish a striking resemblance between submarine agriculture, and agriculture properly so called. An oyster is cultivated as a grain of wheat."

The paper which I have hastily prepared for the Institute is mainly a grouping of facts obtained from two authorities:—
1. An interesting pamphlet, in the Freneh language, by Monsieur le Docteur J. L. Soubeiran, Secretary of the Imperial Society of Acclimatization of France, kindly forwarded to me by the author.
2. The Harvest of the Sea, by James E. Bertram, an English author. The former is dated 1866; the latter 1865—both recent works.

"About fifteen years ago," writes Mr. Bertram, "there was scarcely an oyster of native growth in France." The beds had been so exhausted from over-dredging as to be unproductive; and the people were consequently in despair at the loss of their favourite luxury, and had to resort to other countries for their supply. It was under these circumstances that M. Coste instituted that plan of oyster-culture which has proved so successful. To prepare the way for a reference to M. Soubeiran's paper on the oyster-parks of Arcachon, let me continue to condense Mr. Bertram's description of French oyster-culture. At the instigation of the French government, M. Coste made a voyage of exploration round the coasts of France and Italy, in order to enquire into the condition of the sea fisheries; and to see

how these fisheries could be artificially aided, as the fresh water fisheries had been aided through the re-discovery by Joseph Remy of the long forgotten art of pisciculture. It was from observing the process of oyster-culture at Lake Fusaro in Italy, that M. Coste conceived the project of introducing oyster-culture into France. The mode of oyster-breeding at this place was, to erect artificial pyramids of stones in the water, surrounded by sticks of wood, in order to intercept the spawn, the oyster being laid down on the stones. Faggots of branches were also used to collect the spawn.

In this place I may describe the manner in which the spawn or "*spat*" of the oyster is collected, and its further development secured. Oysters do not leave their ova, like many other marine creatures, but incubate them in the folds of their mantles, and among the *laminæ* of their lungs. There the ova remain surrounded by mucous matter, which is necessary to their development, and within which they pass through the embryo state. The mass of ova, or *spat* as it is familiarly called, undergoes various changes in its color, meanwhile losing its fluidity. This state indicates the near termination of the development, and the sending forth the embryo to an independent existence; for by this time the young oyster can live without the protection of the maternal organs. The animated matter escaping from the adults on breeding banks (the oyster is considered to be an hermaphrodite) is described as resembling a thick mist being dispersed by the winds—the spat is so scattered by the waves that only an imperceptible portion remains near the parent stock. All the rest is dissipated over the sea space; and these myriads of animalculæ, tossed by the waves, either attach themselves to solid bodies, or fall victims to the larger animals which prey upon them. The spawn, as found floating on the water, is greenish in appearance, and each little splash may be likened to an oyster nebula, which resolves itself, when examined by a powerful glass, into a thousand distinct animals. By the aid of the microscope, the young animal can be seen with its shell perfect, and its holding-on apparatus, which is also a kind of swimming pad, ready to clutch the first solid substance that the current may carry it against: hence the economy of artificial

appliances for collecting them. At the age of three months an oyster is not much bigger than a pea; and the age at which reproduction begins has never been accurately ascertained, but it is thought to be three years. Oysters are usually four years old before they are sent to market. At the age of five years it is at its prime; and its average duration of life is said to be ten years.

To return to M. Coste and his experiments. The Lake Fusaro system of cultivation was therefore, at the instance of their *savans*, strongly recommended for imitation by the French Government to the French people, and experiments were at once entered upon with a view to prove whether it would be as practicable to cultivate oysters as easily among the agitated waves of the open sea, as in the quiet waters of Fusaro. In order to settle this point, it was determined to renew the old oyster-beds in the bay of St. Brienne, and notwithstanding the fact that the water there is exceedingly deep and the winds very violent, (situated opposite the English coast west of the old sea-port of St. Malo,) immediate and almost miraculous success was the result. The fascines laid down soon became covered with seed, and branches were speedily exhibited at Paris, and other places, containing thousands of young oysters. (A half a million is on the average the amount of spat which an oyster can "brew" in one season.) In less than six months the success of the operation in the bay of St. Brienne was assured, the fascines being so thickly coated with young oysters that an estimate of 20,000 for each fascine was not thought an exaggeration.

While M. Coste was, however, exploring the coasts, and studying Italian oyster culture, and in giving a practical direction to the knowledge he acquired; a shrewd observer, a mason named Bœuf, began simultaneously to think of oyster-culture in France. He began by trying the experiment on a small scale, so as to obtain a practical solution of his "idea," and with this view he enclosed a small portion of the foreshore of the island of Re, by building a dyke of about eighteen inches in height. In this park he laid down a few bushels of growing oysters, placing amongst them a quantity of large stones, which he gathered out of the surrounding mud. This initiatory experiment was so suc-

cessful, that in the course of a year he was able to sell £6 worth of oysters from his stock. He continued to increase the dimensions of his farm, so that by 1862 his sales had increased to £40. Bœuf's neighbours witnessing his good fortune, soon ceased to ridicule his enthusiasm, and began to cultivate for themselves. The system soon extended over the foreshore of the island, so much so, that what were formerly a series of enormous and unproductive mudbanks, occupying a stretch of shore of about four leagues in length, are now so transformed, and the whole place so changed, that it seems the work of a miracle. This island, which may be designated the capital of French oysterdom, has now 4000 fish-farms upon its shores, more than all the rest of the coast put together, and the people may be seen as busy in their fish parks as the market gardeners in the *environs* of a populous city.

The marked success that had attended the efforts of these pioneers in the art of oyster-culture, stimulated the friends of national industry, with the aid of the government, to apply the experiment to the restoration of the old oyster grounds, which had seriously declined in their yield. The most important of these were in the Basin of Arcachon on the south-west coast of France, in the Golfe de Gascoigne or Bay of Biscay, situated about 100 miles south of the famous Ile de Re. It is upon the subject of the revival of the oyster fisheries in this locality, that the pamphlet I have referred to treats. The basin of Arcachon had produced from time immemorial considerable quantities of oysters, greatly esteemed owing to the peculiarity of the soil upon which they were propagated. "For many years," remarks M. Soubeiran, "the Basin of Arcachon was the *Eldorado* of oysters. The basin contributed amply to the wants of the country; and numerous vessels were employed in transporting them to neighboring countries. But by reason of trespass during the spawning time, when dredging was prohibited by the laws, and by reason of furnishing oysters to all France, England, Holland, and other countries, they had exhausted the mine which they thought to be inexhaustible; and in consequence, suddenly (in literal French, *un beau jour*—one fine day) they found the harvest so diminished as to become

almost insignificant. They had killed the fowl for the sake of the golden eggs!

This basin at high tide has the appearance of a small interior sea of about 100 *kilometres* (57 miles) in circumference, partaking of the flow and ebb of the ocean. It furnishes two sorts of oyster grounds—the *crassats*, or exposed lands, and the *chenals* (channels), which are never exposed. It appears that two prominent causes of the decline of the oyster fishery in this basin, were the accumulation of mud on the neglected banks, which is destructive to the oysters, and the ravages from the Bigornian borers (*Nassa reticulata*—(whelks) Buccinidæ), which are so numerous, that in a single tide of two hours, twelve sailors of the government vessel have taken at a season when they are most abundant, (March), 14,600 of them in a space of 40 *hectares* (20 acres). (M. Soubeiran remarks in a foot note, that the smallest Bigorneaux, placed upon shells garnished with 15 to 20 young of the oyster, pierce them one after another, and do not quit the shell until they have finished the last. They pierce in a half hour an oyster of one month; they are more formidable even than the adult Bigomeaux, which take eight hours to perforate the shell of an oyster of three years, and which do not make war upon oysters of a greater size.)

The oyster grounds are thus described:—"Upon the half of this vast bay, on the eastern side, are seen about a hundred floating habitations, above each of which rises a column of smoke like that from the chimney of a little steamboat. These are (*pontons*) which serve for the lodging of the keepers of the oyster depots. Ordinarily they are located in the centre of these narrow but rich domains, composed of about (4 *hectares*) two acres. A buoy bearing the number of the *depot* or claim, painted large so as to be easily seen, in white on a black ground, is placed at one of the extremities of each proprietary, and remain visible at high water. Stakes of branches of pine, distributed from point to point, and describing either circles, or irregular rectangular figures, fix the limits of each park."

Towards restoring the oyster-fisheries of Arcachon to their ancient fertility, the Government, upon the suggestion of M. Coste, established *experimental or model parks* at three

points of the Basin, at *Grand-Ces*, *Crastorbe* and *Lahillon*, and these model-farms have given results so wonderful that they must soon furnish more oysters than the entire basin furnished before, and give the assurance that the whole bay will easily be rendered fertile. These facts are verified by the report of *M. Chaumel*, the Commander of the Government vessel employed in replenishing the banks, and overseeing the oyster-grounds. Two of these *Imperial parks*, embracing a total surface of 22 hectares, were established in 1860 upon *crassats* where oysters already existed. From that time to 1866, a million of oysters were thrown over the parks, 100 cubic metres of shells of *Sourdon* (*Cardium edule*) were laid, and one hundred and ninety-seven *collectors* distributed over the flats. These collectors, besides the shells of the Sourdon, became covered with spat, and although from 1862 to 1865 eight millions of oysters had been removed to supply various localities near and remote, there remained in the parks, in large and small oysters, about sixteen millions. This result was the experience of six years, where about one million of oysters only existed. Including the million of oysters that were added to these, the increase in six years was 1150 per cent., or twenty-two millions. The third *Imperial* park, *le parc de Lahillon*, was established upon a part of a *crassat* of about *twenty acres* in size, and occupied about two acres. When they commenced their labour, the oysters were so few that a premium was offered for every oyster that could be found. During 1863 and 1864 they sowed 178,000 oysters. At the same time they placed 250 tiles and a quantity of oyster shells and of Sourdon shells to serve as collectors. In the first year the result was very satisfactory; for they counted about sixty spat per shell, and an average of one hundred per tile. In 1865, they completed the number of 500,000 oysters sown, and replaced those they had sold by the same number taken from one of the other parks. They also laid a large number of tiles and other collectors. The result of this year showed—

Young oysters	on the tiles,	1.259.248
do.	on the *Huitres meres*,	2.680.000
do.	on the shells and stakes,	1.246.000
		5.185.248

The facts that I have adduced prove undeniably that oyster-culture on a favourable soil, and pursued with zeal and perseverance, is attended with extraordinary success. It remains now but to refer briefly to one or two special points that may elucidate further this interesting branch of industry.

1. *The Collectors.*—I have already described the *fascines* that were first employed; but beside these, and the oyster and mussel shells that are used for this purpose, another kind of collector was constructed for the Imperial parks. These collectors were formed of eight planks of 2 metres long, 25 centimetres wide, and sustained 25 centimetres above the soil by uprights with cross-pieces. These planks were covered on their under side with bushes to collect the spat, or with shells fixed on with resin. The tiles are also supported above the soil by cross-pieces of wood.

2. *The work of the cultivators.*—There is constant employment on an oyster-park; and the diversity of the seasons only varies the nature of the labour. It is true that the labour all the year through is not of the same amount and importance. Augmented at the period of sowing (April and May), and chiefly at the harvest time (September and February), there is a period of comparative rest in the spawning season (June, July and August.) During these months it is the care of the *ouvriers* to prevent the ground from being disturbed, and to protect the spat from the enemies that prey upon it. But the principal labour begins in September and is prolonged until May. A general inspection of the whole park is the signal of the arrival of the busy season. The soil is then purged of all useless and injurious matter; hurtful plants are removed, and the soil is brought to a fit state for cultivation. After the preparatory labour the barren oysters are removed, and the remaining ones in some cases transported to other spots. Each age has its compartment. At about ten months old, the spat are removed from the collectors,

and sown in squares. At this period the shells are of a consistence to permit them to be detached from the collector without endangering the life of the mollusc. Occupations of this nature require many employees. The overseer surveys the whole, directs them, and distributes to each his *role*. The wives assist their husbands in all the lighter labours. Some cleanse the collectors, others remove the *debris;* some sow the seed-oysters, others sort the mass, separating those that are merchantable, and disposing them in baskets, others carry them to their destination; while all wage war against the enemies of the precious mollusc, as ducks, fishes, crabs and whelks—the two last terrible enemies from the union of their attacks.

3. *The productiveness of the system.*—Mr. Bertram remarks, "A gentleman from Jersey, who explored the oyster-beds in the bay of Arcachon, was informed by one man who had laid down 500,000 oysters, that they had increased in three years to 7,000,000. And at Ile de Re the inspectors counted 600 full-grown oysters to the square metre," and he adds, "seeing that 630,000 square metres are now under cultivation, it follows that the oysters in this tract of desert mud are worth from six to eight millions of francs, the total crop being (at the time spoken of) 378,000,000 of oysters."

4. *Cost of production, and profit.*—Monsieur Soubeiran gives *as a short harvest* ascertained from the results at Arcachon, 4000 francs per *hectare* (½ acre) at a cost of 750 francs (500 per cent.); and Mr. Bertram gives a statement of the results at Brienne in 1860 that is almost incredible, viz:—60,000 francs for an expenditure of only 221 francs. This, however, must have been an extraordinary spatting year.

Much might be said, and that of an instructive character, as to the economic value of oyster-culture as a branch of national industry; and on this subject our French author has some admirable remarks, recommending this industry, as affording employment to the maritime portion of the people, and augmenting the sources (de l'alimentation publique) of food for the whole population.

As to the application of oyster-culture to other countries, much depends upon the nature of the soil. Muddy ground is

excellent for the *growth* of oysters; they grow in such localities very quickly, and become saleable in a comparatively short space of time; and this is the kind of soil that is so productive at Ile de Re and at Arcachon. Dry rocky ground is not so suitable for the young oyster, as it does not find a sufficiency of food upon it, and consequently languishes and dies. Marl is the most esteemed, as the oyster finds plenty of food, constant heat, and perfect quiet.

Whether oyster-culture may be successfully practised in Nova Scotia is a question that I have not treated upon, but it is worth a trial; it has done much, very much for the poor fishermen of France, having placed upon the shores of that country 7000 marine farms, affording employment to a very large proportion of the population.

Art. VI. On the Meteorology of the Caledonia Coal Mine, Little Glace Bay, Cape Breton, in 1867. By Henry Poole.

(Read February 3, 1868.)

The Caledonia Mine is situated in the County of Cape Breton and Province of Nova Scotia, in North America, latitude 46° 12′ north, and longitude 59° 57′ west from Greenwich.

It is on the eastern side of the Island, about one mile distant from the shore, and the house at which the observations have been recorded is at an elevation of sixty feet above the sea.

The tides have an average rise and fall of four feet. There are no high lands in the neighbourhood. The land extends from the east by south round to the north-west, while from the north and east the influences of the Atlantic storms and currents are felt in full force. Drift ice retarding the vegetation of spring, and the Arctic currents lowering the normal temperature of summer and autumn; while the higher temperature of the sea, and perhaps a partial influence of the Gulf Stream, keeps a milder temperature in the early part of winter, and our Bay open for navigation much longer than I have observed at Pictou and other places in the same latitude but further removed from the ocean's influence.

The instruments used are a barometer with fixed ivory pointer in a glass cup, to which the surface of the mercury is adjusted, made by Green, of New York, Instrument maker for the Smithsonian Institute. Mercurial thermometers to show the day's temperature in Fahrenheit, and two thermometers graduated in centigrade degrees for showing the relative humidity and force of vapour, also made by Green. A horizontal spirit thermometer made by Negretti, registers the extreme temperature at night; these thermometers are placed on the outside of the house with a N. E. aspect, 6 feet above the ground, and about three inches distant from the wall. The directions of the wind are true north, &c., and not magnetic, (the variation of the needle being N. 25° W. at the present time). The velocity of the wind is recorded by one of Negretti and Lambra's Cup Anemometers, calculating 1000 revolutions to equal a mile. The greatest velocity observed was on the 13th December, 34740 revolutions for 12 hours, equal to 58 miles an hour, and the calmest night was 24th November, when there were only 277 revolutions in 15 hours, equal to 3 6-10 miles an hour. The force of the wind is also shown by a board one foot square, made to face the wind, and acting against a spring Salter's balance. It therefore shows the extreme force of any squall; but as there is a good deal of friction the machine is not acted upon by very light winds. On the 17th January, during the night it marked 44 lbs., being the extreme limit marked on the machine. On the 3rd August a gale from the west marked 40 lbs. pressure on the square foot, and equalled a velocity for 6 hours of 53 miles an hour.

The rain is measured by a square zinc box placed on the ground, with a funnelled mouth ten inches above the ground. The snow is collected in a zinc pail three feet deep, hung like a ship's compass, at five feet from the ground, so that drifted snow does not blow in; and when melted is included in the total quantity of rain recorded to have fallen in each month.

A meteorological register was kept at the Albion Mines for eleven years; and though only one year has been kept at present at the Caledonia Mine, I have thought it would be interesting to compare them together.

The barometrical readings have nothing marked to distinguish the one locality from the other; and the same characteristic is observed here of a rapid rise or fall following each other

TON, 60F

Wind total Revolutions.
758644
802678
659698
615098
629463
619496
540656
535202
592640
665252
613918
689670
7722414
154448 Miles

E 62° 42'

....

September.

There was fewer days of snow (52) at the Caledonia Mine,

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

1867	Barometer Corrected. Temp. reduced to 32°.	For height 165 ft. 069 –F of Vap.	Highest.	Lowest.	Thermometer. Mean night.	Mean Noon	Mean.	Coldest.	Hottest.	Relative Humidity.	Force of Vapour Millimetrs.	Degrees of Frost below 32.	Nights of Frost.	Below Zero.	Rain. Days.	Inches.	Snow. Days.	Inches.	Wind total Revolutions.	Miles per hour anemometer.	Extreme pounds pr. foot square.	Least Revolutions in 12 hrs pr. anemometer.	Greatest Revolutions in 12 hrs per anemometer.	Halos. Sun.	Moon.	Northern Lights	Lightning. Thunder.	Fogs.	Wind round with Sun.	Wind round against Sun.	Silver Thaw.	Rainbows.	Wind. S. to W.	W. to N.	N. to E.	S. to E.
January	29·600	29·551	30·235	28·900	19·0	26·0	22·5	-10	37	76·6	2·77	392	31	2	9	5·915	9	44	758644	20·4	44	606	32782	..	..	..	..	2	2	2	..	..	8	12	5	6
February	29·864	29·825	30·768	29·285	16·7	27·0	21·5	-5	50	75·0	3·02	454	26	2	12	3·395	7	10¼	802678	23·6	20	4260	26052	1	..	..	..	..	1	..	1	..	8	14	4	2
March	29·903	29·849	30·527	28·791	17·4	29·5	23·3	-2	44	73·1	2·90	465	30	1	11	5·965	9	16½	659698	17·7	9	1088	23594	2	..	3	..	..	3	1	..	..	3	12	8	8
April	29·805	29·704	30·299	29·092	26·0	40·3	33·6	19	57	75·3	4·13	129	27	.	15	5·085	9	15¼	615098	17·0	12	924	23570	2	..	1	1	2	2	2	..	7	9	3	11
May	29·857	29·681	30·358	29·364	37·0	49·2	43·1	24	71	74·3	6·26	16	5	.	14	5·370	1	2	629463	16·9	7	457	27299	2	..	3	..	3	5	2	..	1	6	10	6	9
June	29·965	29·726	30·322	29·590	47·2	60·8	54·0	32	78	88·6	7·716	.	1	.	12	2·014	"	"	619496	17·2	14	940	22575	2	..	1	1	2	3	1	..	..	11	10	7	2
July	29·834	29·477	30·283	29·376	59·5	66·7	60·1	43	80	71·7	10·578	.	.	.	13	3·080	"	"	619656	14·5	3	2174	15960	1	..	..	3	4	5	2	..	..	11	8	6	6
August	29·950	29·481	30·322	29·644	58·6	74·7	66·6	45	85	65·3	13·454	.	.	.	7	2·560	"	"	535202	14·4	40	1962	21954	1	..	7	..	4	5	..	..	..	15	5	1	10
September	29·954	29·651	30·289	28·676	49·9	62·3	56·1	36	75	72·6	9·097	.	.	.	11	11·265	"	"	592640	16·4	7	626	22200	2	..	9	2	3	5	1	..	2	12	8	4	6
October	29·913	29·736	30·500	29·150	39·0	50·0	44·5	28	63	73·0	6·001	12	7	.	11	2·920	1	"	665252	17·8	10	660	22615	2	2	1	1	1	3	2	..	3	11	11	4	5
November	29·812	29·671	30·279	29·064	31·5	40·6	36·0	15	59	73·4	5·093	125	14	.	16	4·760	3	9¾	613918	17·0	9	277	33110	1	..	1	..	3	1	..	..	..	14	10	2	4
December	29·737	29·691	30·369	28·912	13·7	24·4	19·1	-4	43	79·5	2·705	578	31	2	16	5·745	13	27¼	689670	18·5	12	2564	34740	..	1	..	1	1	1	4	2	..	16	5	4	6
Extreme			30·768	28·676				-10	85		In. 2438	2171	172	7	147	58·090	52	Ft. in. 9·3½	7722414	17·6	44	277	34740	16	3	26	9	25	36	17	5	6	122	114	54	75
Mean	29·8524	29·6704			34·17	45·95	40·06			72·87	6·194								154448 Miles																	

CLIMATE OF THE ALBION MINES, NOVA SCOTIA, LATITUDE 45° 34′ 30″ N. LONGITUDE 62° 42′ W., FROM GREENWICH, 120FT. ABOVE SEA.

10 years	29·7137	.....	30·757	28·505	33.11	50.31	41.97	-22	98		...	2470	189	19	173	44·967	63	Ft. in. 10·5	....	..	..	...	....	..	..	..	19	..	..	...	..	..	112	126	66	61

The barometrical readings have nothing marked to distinguish the one locality from the other; and the same characteristic is observed here of a rapid rise or fall following each other within a few hours; which is not the case in England as recorded by Howard's Climate of London.

The mean temperature here 40.06 Fah. is about two degrees colder than at the Albion Mines, 41.97. The mean difference of the days being five degrees colder, and the nights one degree warmer. The most marked difference being 6.82 in January, and 5.75 in February, warmer at night at the Caledonia Mine; which also accounts for the difference in the total degrees of frost below 32, Caledonia being 2171, and Albion Mines being 2470 degrees of frost for the year. August and September are slightly in excess of mean temperature, and also for the nights in October and November, showing that the frosts keep off longer, and that grains and vegetables would ripen here also, if the farmers only paid proper attention to draining and cultivation.

The relative humidity and force of vapour were not tabulated at the Albion Mines, so no comparison has been made, but an average per centage of 72.87 of humidity, with a force of vapour so high as is shown in June, July, August and September, shew very favourably for rapid vegetation.

The extremes of temperature are much greater at the Albion Mines than at the Caledonia, the former ranging 120 degrees, or from 98 to 22 below zero, the latter ranging only 95 degrees, or from 85 to 10 below zero. At the Albion Mines the average of nights below zero was 19, while at the Caledonia Mine in 1867, there were only 7. There were more rainy days (173) at the Albion Mines, giving 44.967 inches, than at the Caledonia (147) giving 58.090 inches; but it will be observed that the quantity was in excess 13.123 inches at Caledonia Mine. June was the dryest, and September the wettest month.

There was not any frost in July, August or September, while at the Albion Mines on an average there was frost every other year on one night in July, August, and for five nights in every September.

There was fewer days of snow (52) at the Caledonia Mine,

measuring 10 feet 5 inches, than at the Albion Mines (63 days) measuring 9 feet 3½ inches, and the snow was not so dry at Caledonia, yielding more water, owing no doubt to the proximity and influence of the ocean.

There is not much difference in the direction of the winds :—

Caledonia Mine—S. to W. 122, W. to N. 114, N. to E. 54, E. to S. 75.

Albion Mine—S. to W. 112, W. to N. 126, N. to E. 66, E. to S. 61.

No registering instrument was kept at the Albion Mines of the daily velocity; but I consider the wind must be above the average velocity at the Caledonia Mine, and I should like my register to be compared, if possible, with the one kept at the Citadel Hill, Halifax, or other places having nearly the same latitude.

The mean temperature of December was the coldest in 1867, but that I think was exceptional, as December 1866 was four degrees warmer. I therefore assume December, January, February and March nearly alike, and average about 22 degrees; April and November nearly correspond, and are about 12 degrees warmer; May and October are about the same and 9 degrees warmer; June and September are again about 11 degrees warmer; July 6 degrees warmer than June; and August 6 degrees warmer than July, and 10 degrees warmer than September. September has a mean of 56 degrees, which corresponds with the temperature of the whole year at Vienne, in France, in nearly the same latitude but on the opposite side of the Atlantic.

The length of the longest day is 15 hours and 23 minutes, and of the shortest day 8 hours and 37 minutes.

The greatest range of temperature for the whole year was 95 degrees; for one month (February) 55 degrees; the least range in one month (October) 35 degrees.

As a good deal has been written about the veering of the wind and rotation of storms, I fastened a string to the wind-guage, and found that it made thirty-six coils turning round with the sun, and seventeen coils turning back against the sun,

during the course of the year. There does not appear to be any regularity or uniformity either in direction or time. In January the wind backed on the 17th, and a gale from S. E. on the 18th marked a pressure of 44 lbs per square foot. On the 21st the wind went round with the sun, and a gale from E. and N. lasted for the next three days. Another gale on the 30th was from the N. W. In February the wind was high all the month; the heaviest gale on the 10th and 11th began from S. W. and S., then went to N. W., and the wind made one entire revolution with the sun during the whole month. In March there was not any very heavy gale, only high wind on the 2nd from the S. with rain, on the 18th from N. W. with snow, and on the 27th from S. E. with mist, after which the wind went round against the sun. On the 17th April the wind backed from E. N. E. to E. S. E. and blew for three days, with snow and sleet, producing a silver thaw. On the 2nd May a gale with rain from S. S. W. On the 18th wind round with the sun from N. to E., blew a gale all the 19th from the north, and lobsters and codfish driven on shore in large numbers. On the 4th June a snow storm with wind from the west; 5 feet of snow fell between Cape North and Grandance; on the 19th a gale from W. S. W. with light showers of rain. In July the highest winds were on the 1st from the west, and on the 29th from the S. W., but neither of them amounted to a gale. On the 3rd August a gale from the S. W. blew down trees, and the dry wind blasted the leaves of many plants, and withered them. On the night of the 1st September, with high wind from S., rain measured from 6 p. m. to 8 a. m. on the 2nd, or fourteen hours, the unusual quantity of 4 33-100 inches. On the 30th a gale from S. E. all day with lightning and thunder, and continued on the 1st October from the S. W. High wind on the 6th from S. E. with rain, and on the 26th from north with rain. On the 2d and 3d November with squalls of rain from W. N. W.; on the 13th gale from S. S. E.; on the 16th from the S. E.; and on the 30th from S. E. then S. with three quarters of an inch of rain. On the 14th December a snow storm from the north blew 68230 revolutions in the 24 hours, equal to a velocity of 1364 miles; or at a rate of 56.8 miles per hour. There was also a

gale from the S. E. on the night of the 27th, accompanied with lightning and thunder.

On the 15th February the first drift ice was seen passing to the south.

On the 10th March very fine Aurora Borealis, showing five lines of curtains, one above the other at 8 p. m., colored, and extending from Corna Berenicis to Capella.

March 29th, heard blue birds singing,—28th ice left the Bay.

April 10th, saw a small butterfly, heard robins,—12th, first herrings caught in the Bay,—16th, frogs heard.

May 6th, saw first bee,—13th, first snake, brown,—16th, first swallows.

June 4th, heard musquito hawks,—5th, dandelion in bloom,—9th, heard a loon,—12th, saw swallow tailed butterfly,—13th, blue butterfly and Camberwell beauty.

July 8th, fireflies,—14th, bat,—19th, gathered mushrooms.

August 6th, flight of winged ants,—20th, curlew and plover arrived.

October 22nd, saw a glowworm by side of the road.

November 5th, tide ebbed and flowed four times.

December 8th, "cock-a-wies (anas glacialis) in the Bay; they remain here all winter, and go north in spring,—11th, wild geese last seen in the bay,—31st was the coldest day in the year, when the thermometer marked 4 below zero at night, and only 1 degree above zero at noon. Shocks of earthquake were felt throughout the State of New York; the barometer on the 1st January, 1868, stood at 30.53, with thermometer attached, at 42; and on the 2nd January, barometer 28.97, with thermometer attached 50, showing a fall of 1.56 inch of pressure in 24 hours, and though occurring in 1868, I have mentioned it, as it may have been caused by the earthquakes which were being felt in the United States and Canada.

Table of Temperature at the Albion Mines compared with Caledonia Mine. The sign † shows the Caledonia Mine was warmer. The sign –, colder than the Albion Mines.

Caledonia Mine, 1867.	Mean Noon.			Mean Night.			Daily Mean.		
	Albion Mine.	Caledonia Mine.	Difference.	Albion Mine.	Caledonia Mine.	Difference.	Albion Mine.	Caledonia Mine.	Difference.
January	25·46	26·0	†·54	12·18	19·0	†6·82	18·84	22·5	†3·66
February	28·07	27·0	–1·07	10·95	16·7	†5·75	19·52	21·8	†2·28
March	36·13	29·5	–7·08	17·85	17·1	–·75	26·98	23·3	–3·68
April	46·24	40·8	–5·94	27·64	26·9	–·74	36·90	33·6	–3·30
May	59·28	49·2	–10·08	37·63	37·0	–·63	48·44	43·1	–5·34
June	69·99	60·8	–9·19	46·63	47·2	†·57	58·29	54·0	–4·29
July	77·80	66·7	–11·10	54·92	53·5	–·42	65·94	60·1	–5·84
August	76·34	74·7	–1·64	55·39	58·6	†3·21	65·85	66·6	†·75
September	65·64	62·3	–3·34	46·59	49·9	†3·31	56·09	56·1	†·01
October	53·88	50·0	–3·88	38·52	39·0	†·48	46·34	44·5	–1·84
November	42·25	40·6	–1·65	30·35	31·5	†·75	36·27	36·0	–·27
December	29·87	24·4	–5·47	18·65	13·7	–4·95	24·21	19·1	–5·11
Year	60·91	45·95	–4·96	33·11	34·17	†1·06	41·97	40·06	–1·91
Winter	27·80	25·80	–2·00	13·93	16·47	†2·54	20·86	21·13	†·27
Spring	47·22	39·66	–7·56	27·70	27·00	–·70	37·44	33·33	–4·11
Summer	74·71	67·40	–7·31	52·31	53·10	†·79	63·36	60·23	–3·13
Autumn	53·92	50·96	–2·96	38·49	46·10	†1·61	46·24	45·33	–·91

The temperature at Caledonia Mine is colder during the day than at the Albion Mines, except in January. During the night Caledonia Mine is warmer in January, February, June, August, September, October and November, and colder in March, April, May, July and December.

1867 Dec'r. has been unusually cold. In 1866 the mean temperature was 23 degrees or 4 degrees warmer.

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

No. IV.

(Read April, 1868.)

IN the last papers I have had the honour to read before you, you may recollect I considered the very marked and boreal family of weasels. Following the classification of the Smithsonian Institute, I shall bring to your notice this evening the somewhat aberrant group of the otter, the skunk and the raccoon. The otter, a boreal fauna, and allied to the mink,—the skunk and the raccoon, almost the sole representatives of a more southern fauna, and perhaps our latest arrivals in point of time. But to give to the paper a greater completiveness, I will enumerate the whole fauna of the Province as identified by myself. I think this list will include all, with the exception of a shrew, or a mouse or two, yet to be added—I know of no other list except my own, and in using the term identified by myself, I only wish to add to it the interest of personal verification. I shall use the classification of Dr. Baird (Smithsonian Institute), with the synonyms of Sir John Richardson when procurable, thus using the best American and English authorities, being satisfied that whilst no one can be but charmed by the accuracy, exactness and minute description of the great English traveller; on the other hand they must equally acknowledge the exhaustive labour of the American naturalist, though they may differ from him in some of his conclusions.

CHEIROPTERA,—Bats.

Vespertilio Subulatus, (Say, Richardson), Say's-bat.
Vespertilio Cinereus, (P. D. Beauvois), 1796) } Hoary Bat.
Vespertilio Pruinosus, (Richardson), }

Dr. Allen, (Monograph American bats 1864,) puts this last species in the new genus "Lasiurus." It is very rare in the Province, whilst Say's bat is very common. Capt Hardy gave me a bat whose interfemoral resembled "evotis" (Allen). I am unwilling, however, to make it this species.

INSECTIVORA,—Shrews.

Sorex Palustris, (Richardson,) Marsh Shrew.
Sorex Fosteri, (Richardson,) Foster's Shrew,

Sorex Platyrinus, (Baird,) Eared Shrew.
Sorex Thomsoni, (Baird,) Thomson's Shrew.
Sorex Acadica ? (Baird,) Nova Scotia Shrew.
Blarina Talpoides, (Gapper, Baird.)
Blarina Brevicauda, (Say, Baird.)
Blarina Angusticeps, (Baird.)
Blarina Cinerea, (Backman, Baird.)
Condylura Cristata, (Baird.) } Star-nose Mole.
Condylura Macroura, (Richardson.) }

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

CARNIVORA,—Flesh eaters.

Lynx Rufus, (Guldensteadt, Baird,) Wild Cat.
Lynx Canadensis, (Geoff, Baird,) } Loupcervier.
Felis Canadensis, (Richardson,) }
Canis Occidentalis, (Richardson,) Wolf.
Vulpes Fulvus, (Richardson,) American Fox.
Mustela Pennanti, (Erxleben,) *Canadensis*, (Richardson,) Fisher.
Mustela Americana, (Turton, Baird,) *Martes*, (Richardson,) Marten.
Putorius Cicognanii, (Bonaparte, Baird,) Small Weasel.
Putorius Richardsonii, (Bonaparte, Baird,) *Erminea*, (Richardson.)
Putorius Noveboracencis, (Dekay, Baird,) White Weasel.
Putorius Vison, (Richardson, Baird,) Mink.

Putorius Nigrescens, (Audubon, Baird,) little Mink.

Lutra Canadensis, (Sabine, Richardson,) Otter.

Mephitis Mephitica, (Shaw, 1792, Baird,) *Americana*, (Richardson,) Skunk.

Procyon Lotor, (Richardson, Baird,) Raccoon.

Ursus Americanus, (Pallas, Richardson, Baird,) Bear.

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

Rodentia.

Sciurus Hudsonius, (Pallas, Richardson,) Red Squirrel.

Pteromys Hudsonius, (Gmelin, Baird,) *Sabrinus*, (Richardson,) Flying Squirrel.

Tamias Striatus, (Linn. Baird,) *Lysteri*, (Richardson,) Ground Squirrel.

Arctomys Monax, (Linn., Baird, Richardson,) Wood Chuck.

Castor Canadensis, (Kuhl, Baird, Richardson,) American Beaver.

Jaculus Hudsonius, (Zimm., Baird,) *M. Labradorius*, (Richardson,) Jumping Mouse.

Mus Decumanus, (Pallas,) Brown Rat.

Mus Musculus, (Linn,) Common Mouse.

Mus Rattus, (Linn,) Black Rat.

Hesperomys Leucopus, (Rafinesque, Baird,) White-footed Mouse.

Hesperomys Myoides, (Baird,) Hamster Mouse.

Arvicola Gapperi, (Vigors, Baird,) Gapper's Mouse.

Arvicola Riparia, (Ord, Baird,) Meadow Mouse.
Fiber Zibethicus, (Baird, Richardson,) Musk Rat.
Erethizon Dorsatus, (Linn., Baird,) *H. Pilosa*, (Richardson), Porcupine.
Lepus Americanus, (Erxleben, Baird, Richardson), Hare.

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

Ruminantia.

Cervus Alces, (Linn., Richardson,)
Alces Americanus, (Jardine, Baird,) } The Moose.
Alces Muswa, (Richardson,)

Rangifer Caribou, (Ham, Smith, Baird,)
Cervus tarandus sylvestris, (Richardson,) } Caribou, Reindeer.

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

In not adding Meriones (Jaculus) Acadica, (Edn. New Phil. Journal, 1856,) to the list, I owe it to so learned a naturalist as Dawson to explain that the specimens upon which he founded his new species, and which he obtained from Mr. Winton, Halifax, were prepared for myself, and described as the young of J. Hudsonius, (Zimm.,) in a lecture before the Mechanic's Institute, Halifax, about 1850, and that though being unwilling to differ from him, and still more unwilling to lose a mammal from our Province, I still retain my opinion. Of animals not identified by myself, but sometime to be found in the Province, I think the Virginian deer (Cervus Virginianus) will be found in the Cobequid hills, as I personally know they have been taken at Dorchester, N. B., near the boundary line. There is a tradition of a wolverene (Gulo luscus) having been taken in the same wild country. A large black squirrel skin (Sciurus Carolinensis) with nigritism, was given me from Cumberland. Of the Pinnipedia or seals and Cetæ or whales, I have identified none. From the labours of Dr. Gill we unexpectedly learn that our common seal is identical with the European, (P. Vitulina,) and the harp (P. Groenlandica,) and the grey seal (H. Griseus Neilson,) are all common to each continent. This identity running through the fish, amphibious mammals, the sea birds, and larger land mammals, seems a good proof of our common glacial period and gradual emergence. Of extinct species, during historic time, we may enumerate the walrus, with its companion of another class, the great auk. Of prehistoric remains, I only know the solitary gigantic thigh bones of a huge mammal found at Cape Breton. Of those whose early extinction, perhaps in our own times we may reasonably expect, we may enumerate the fisher, (M. Pennanti), now very rare, and next the marten, (M. Americana). Both these great tree weasels require dense cover. The beaver, twenty-five years ago nearly extinct, is rapidly recruiting. The less value of his skin since velvet hats have been patented is not sufficient to account for his re-appearance. The few or no Indians now trapping in our forests is perhaps another cause. With these exceptions, allowing the same influences to exist, I see no reason why we should not retain our present fauna for centuries, including the large

ruminants. Our last arrival was the wolf, endeavouring in vain to rehabit his old domains, to whom the skunk and the raccoon alone give precedence. All these coming in to us from the wild region of the Cobequid hills. Of introduced species, with the exception of the mice, we have only the horse (E. Caballus), and the rabbit, (Lepus Cuniculus). Both these species have been allowed to assume their feral state on Sable Island, a desert island about ninety miles south-east Nova Scotia, in the Atlantic Ocean. Whilst the rabbits in fifty years have returned to one common silver-grey tint with white collars, it is curious to remark how the horse in one hundred and fifty years, the produce no doubt of the New England stock, has returned to the habits and form of the primal stock, or wild horse of antiquity, and reproduced all varieties of color, not only the bay, black and chesnut, but the rarer colors of piebald, duns, isabella's, blue duns, and duns with striped legs and black lists down the back.

We have so far adhered in our paper this evening to strict classification, using the modern acceptation of genus which, unlike the older naturalists' usage, seems to class animals by their differences, rather than by their similarities, (Linnæus classing the elk with the stag, considering his many points of similarity; H. Smith considering only his differences, classing him by himself). Is it too much to say that the modern system of sub-genus has become too fine and wire-drawn, and operates unfavourably to exact knowledge of the habits of the animals themselves, making a speciality of what should be open to all lovers of nature. However this may be, there is another way of studying our fauna far more agreeable, as it connects us with geology and geography, and allows speculation instead of exact measurement and minute detail. This is to take the order of their presumed appearance on our part of the globe. Our Province glaciated to the summits of its hills and then slowly emerging amid towering ice-bergs, and washed by frozen seas, must have first attracted those animals which live by the sea, since this half frozen ocean had long before been floored by mollusks, upon whom countless series of fish had for ages fed and died. The Cetæ then, as they do now on the Arctic

Circle, may have sported and wallowed over Blomidon or the Cobequid. Following them, came those fur clad fish, the seals; then, no doubt, the polar bear now long extinct, may have denned on the Ardoise or trapped seals in Bedford Basin. This accords with geological facts, the shelled mollusks are the floors of ancient oceans. Fish appear long before air breathers in carboniferous strata. The slowly emerging Province may now have dried itself into bog and morass, insect life is humming about the marshy pools. Our one species of bat so like the pterodactyle harmonizes well with the moose, whose stilted leg and cavernous head closely resemble the extinct fauna of ancient time. The caribou or reindeer on whose horn pre historie man has left his early rude carving, soon joined him; then one would suppose the hybernating class, all those who slept out the long Arctic winter's night, the bear, the beaver, the musk-rat, the marmot, the mice and squirrels, all vegetable eaters but the bear, (and he no doubt then,) would follow; the hare would very early put in her appearance together with the porcupine. A more genial clime and a warmer sun now lights our landscape. The Arctic currents turned aside by the rising continent, have swept away the ice bergs. The moose and cariboo browse over the barrens, the beaver and musk-rat form their rushy domes, the various mice collect with the squirrel their little stores of cones and seeds, the hare and porcupine gather their frugal meal of grass or pine. The most of them sleeping out the long wintry night, none preying on the other. And now come the carnivora. The feast has been for ages preparing, the voracious guests steal slyly in to devour it. The shrews, those hardy imps whose tiny limbs are ones wonder, making their needle tracks on snow whose temperature is 18 below zero, may have been of the first arrivals. The fierce and bloody weasels now attack the mice and the hares, on the land, the fish on the water; the corpulent bear now changes his vegetable diet; the northern lynx creeps along, followed ages afterwards by her congener the wild cat; the crafty foxes and stealthy wolves follow, and the guest roll is complete. These now, by natural laws, keep at a poise production, and supply. Presently man makes his appearance, and both guests and viands begin to disappear. By stone arrow

head, by fish bone spear, by rude flint knife, and trap stone axe, by bronze sword, unwieldy matchlock, clumsy musket, Queen's arms, or Minie rifle, as Esquimaux, Micmac, Northman, Frenchman or trader, sporting noble or Englishman; by every art in every nationality, by pit-fall, trap-net, or snare, man more crafty than fox or wolf, more murderous than ermine weazel, wars on all. The flabby Esquimaux, clothed in deer skins, no longer drives the deer; men of the nineteenth century, clothe themselves in broad-cloth spun from the wool of sheep, replacing the deer on our ancient hills. It is consoling to think as we have seen so many of the guests out, we have also in our own time witnessed some late arrivals. Twenty years ago Mr. Downs informed me the skunk was so rare that he had obtained but one skin, and he had some idea of importing a few from New Jersey, where he trapped them as a boy. They have increased so rapidly since, that their skins are quite common in our market. The raccoon has within the last twenty years spread itself along the north side of the valley of Annapolis. They were unknown by the Indians, a certain sign of their strangeness. The beaver is again rapidly increasing in the western counties, though, as yet, unknown in the eastern. Old hunter Hardwicke was said to have trapped the last one in Annapolis county thirty years ago; since then forty or fifty skins come to market from one locality during a year. It is curious too to speculate, that almost the first arrival will be the last seen out. The interior of our Province is divided into several great lake basins, each surrounded by barrens and swamps. From the great Shelburne basin flow the Clyde, the Tusket, the Liverpool, the LaHave into the Atlantic; and the Lequille, the Bear, and the Sissiboo into the Bay of Fundy. This basin is so sterile that no man can live on its borders by the soil, the timber too is too small to tempt the lumberman. Wide shallow lakes, dotted by innumerable islets, break the dreary surface of the sterile bog and barren. Here is the home of the moose, among these islets, secure from bears she hides her fawns. Pressed in on all sides by advancing cultivation, with no back ground of forest, as in Maine, New Brunswick, or Canada, to retreat upon, she here makes her stand, having be-

come almost extinct in those countries. These barrens and intricate impassable swamps will be in future ages to Nova Scotia what the Black forest is to modern Europe. There the wild bull which the Imperial Roman described, still defies in his impenetrable haunt the throng of modern men, and so in ages to come our moose will hold good his feeding ground. Men with their governments will crumble, but the same unutterly barren ranges will still exist; the same countless withered rampikes will rear their spiked heads as now; the same dwarf and scrubby pines will clothe their bases as to-day; yet those whose camp fires are wreathing round these withered spectres, will not be our worthy President, or our friend and member Captain Hardy, whose graphic notes of these scenes we have just published, but perchance the young Princes Royal of Carolina, who have come north with the young Dukes of New York to strengthen their enervated limbs by stalking a moose with the Prince of Quebec, heir of Alfred fourth King of Canada, attended by the Earls of Blomedon and Cobequid. Thus the moose, whose bones have been found mingled with the cave bear, and other mythic phantoms of prehistoric times, may be the last survivor of all.

Taking up in their specific order, each mammal, as I said in the beginning of this paper, I will proceed with the American otter.

Lutra Canadensis, (Sabine, Richardson,) the Otter.

Of the skins examined by me at Halifax, they were all dark liver brown on the back, the under parts lighter. The cheeks, chin, throat and breast were greyish white. The fur was of two kinds, the outside long, brown and shining, the inside soft and lighter. Sir John Richardson gives the colour equally dark below as upon the back. They measured from four to five and six feet, including the tail. They are not very numerous, perhaps six hundred skins may be the annual catch. For so large a mammal, the otter keeps a very close cover, being seldom seen during the summer. In winter when the lakes are frozen he is compelled to take long journeys through the forest in

search of open water. If the snow is deep and no crust, owing to the shortness of his legs, and long low tail, he leaves one uninterrupted trail behind him. I have tracked these for miles, crossed and recrossed by the tracks of grouse, hares, squirrels, shrews, moose, lynxes and bears. The stern solitude of our short Arctic day in the forest is greatly enhanced by the marks of a populous gathering over night. Like Baal's priests, they have all left their footprints behind them. The hunter loves them not—a clear track without a cross shows the beast a few miles ahead. In the lettered page that nature has written on the snow for his guidance, he reads a day, two days, or a week ago, he passed along: memories of these sylvan readings how sweet you are! The otters that I have seen were with broad flat heads, short ears, scarce appearing above the fur, flattened like an angry cat, a broad naked muzzle, thick moustache and round large upper lip, the eye cruel, but inexpressive, light in colour, and too near the nose for beauty; the legs very short and strong, the whole body round, and the tail long and compressed, but joined to the body by a very broad base. In repose they were fond of lying on their bellies, with the hind legs turned up behind, as a duck's foot in swimming. They held their fish in their fore paws, and devoured it by a series of snarling bites. I have no language to express their tortuous, swift and graceful glides in and out the water, and over the ground. They resembled young furred anacondas, not as we see them half alive in our shows, but stimulated by a glorious African sun and burning desert sand. They are said to be fond of sliding down the hills, (moist clay in summer, snowed in winter,) and to continue it for hours. By the best authorities, our otter is specifically distinct from L. Vulgaris, or the European otter, the skull of ours is much broader and larger, and the naked muzzle double the size.

Mephitis Mephitica, (Baird, from Shaw.)
Mephitis Americana, (Richardson, Sabine, DeKay,) Skunk.
Mephitis Chinga, (Tiedman, Wagner, Audubon.)

Of the some dozens of skins of this late arrival among our fauna, which I have examined, they have all been of that

variety which Baird makes typical for the northern skunk. Black, with white line down the forehead, yellowish white rhomboid spot on the back of neck, from which issue from either posterior corner two parallel white lines, soon diverging and losing themselves on the flanks, and a white tip to the tail. I have never examined one in the flesh. From well mounted specimens we recall a handsome lively little animal standing high on pretty feet, a small and arched head, ears small, a high back, and a very fine brush carried over his back. He is bold as well as handsome, and goes out of his path for no one. Once or twice I have met him in the open, by evening twilight, or at noon, trotting through the dark forest. He much resembled a poodle dog, his long curved nails rattling as he ran. The stories of the offensive fluid which he ejects from glands on either side of the rectum are not exaggerated. Though it appears to me that an open cultivated country is much more favourable to its diffusion than a wooded uncultivated one. I have offensively perceived the odour for nine miles. The main land being that distance from the island where I was, and on which none were living. I have never known our forests tainted to so great an extent. One can scarcely believe the greenness of the gentleman who on his wedding tour espied one of these innocents in the road, easily captured it, as they will allow you, and presented it to his bride sitting beside him in his carriage. Cupid loved the soft muff and caress; but a sudden jolt of the carriage alarmed him, and any one who knows them, will never ask what happened then. Equally incredible are the stories of the Indians who love the odour, willingly eating the tainted meat; yet I have heard both vouched for. The specific "Mephitica" was first given by Shaw, but using the genus Vivera. Cuvier, separated it into the genus Mephitis, and Baird, following the strict law of priority, still retains this specific. May I be allowed to say this strict law of priority, allowing, as it does, no writer a choice or alteration of name, is the only compass that will steer us out of that vast ocean of synonyms which threatens to engulf the science?

Procyon Lotor, (Richardson, Baird).
Ursus Lotor (Linn, Erxleben). } Raccoon.

Of the many skins of this also late arrival amongst us which I have examined, as well as living and dead specimens, they agree generally with the description of Audubon, and Baird. I think our raccoons are larger and darker, and among them a greater tendency to negritism. Among many dark skins, I have seen one that in colour resembled the best specimen of the black fox, the rings upon the tail being barely discernible. Usually he is of a yellowish-grey, mixed with long black hairs, and a little rusty thrown upon shoulders and rump. Audubon, speaking of the black patch on either side of the face, says it "passes the eyes over the nose." I think this must be an error of the printer, as all our specimens have the nose very conspicuous, a grey ridge between the spectacled eyes. He is rapidly increasing in our forests, and doubtless hybernates during the winter months. I have never met his tracks in the snow, but have known of his having been cut out of a hollow tree in mid-winter, in which a hog that had escaped and run wild had also taken her temporary refuge. A fowl-house, at a farm where I was one night, was diligently searched to discover the reason of the discordant screams of its inmates. The flare of the lantern, after looking everywhere, was at last reflected by a pair of twinkling eyes in the farthest corner of the roof-tree. We soon had the pretty black paws and beady eyes relaxed in death, much more, I own, to the satisfaction of the farmer than my own. He has penetrated the whole length of the north side of the valley of Annapolis during the last thirty years, in such numbers as to damage the crops of the mountain farms; whilst on the southern side, separated by river and basin, he is unknown. Our Indians did not know him on his first invasion. May we hope that he will make good his quarters, and that his prying, mincing gait, droll frolics, and round, humpy form, commingling agility with strength, may never be wanting to our piney woods or brawling streams.

NOTE.—Les Carbot, who visited Nova Scotia in 1606, speaks of small animals, very round and fat, which had black paws like monkeys, as plenty there at that time. These must have been raccoons. I note this as curious that they should retire before civilization, and then return 300 years afterwards under so different circumstances—to cultivated fields instead of primeval forests, to corn and maize instead of wild fruits and berries.

Art. VIII. On some of the Rarer Birds of Nova Scotia. By J. Matthew Jones, F. L. S.

(*Read April* 13, 1868.)

Although instinct may be considered the primary cause of the periodical migrations of birds, yet the occurrence of severe gales of wind at the time of such migrations, has the effect of moving the migrants to localities, in some cases, far distant from those intended to be visited. Migratory birds are naturally led to visit northern latitudes in spring, for the double purpose of procuring suitable breeding-places, and the proper kind of food to nourish their young ere they arrive at an age when more substantial substances can be taken by them; while their journey south in autumn is a matter of positive necessity, from the entire absence of insect life, and food of nearly all descriptions, while winter reigns with its accustomed severity over the more northern portions of our western hemisphere.

Nova Scotia being situate on the north-eastern extremity of America, and joined by a mere neck of land to the main, appears to be a favourite point for birds to pass over on their course to and from their usual breeding haunts, in the secluded interior of Labrador; and so punctual are they in their movements each season, that unless some unusual change of weather takes place about the time, they arrive at their casual haunts in Nova Scotia almost to a day. The Wild Goose (*Anser Canadensis*) and Golden Plover (*Charadrius marmoratus*), are two instances of the kind. The former, which is the common wild goose of America, makes its appearance in Nova Scotia generally about the first week in March, passing in large flocks at a great height in the air, in a northerly direction. They descend when a favourable resting place attracts their attention, but soon pass onwards on their northern voyage. I am informed that some of these birds do not leave the island of Prince Edward, in the Gulf of St. Lawrence, a little to the north of Nova Scotia, until about the first week in June; but I imagine this occurrence takes place only when the previous winter has been long protracted, and the accumulated ice in the Gulf gives warning to the birds that the far north is not fit for

their reception. I have known them to be as late as the 1st of April in passing north, although this is a very unusual occurrence. This was in 1863. They return south about the 1st of September. The golden plover merely makes Nova Scotia one of its resting places during the autumnal migration, for very few are observed in spring. It arrives very punctually, generally on or about the 22nd of August, and in considerable numbers. It stays about a week, and then passes to the south. It is worthy of remark that the golden plover, in its progress towards its northern breeding places, takes the land-route, passing over the eastern portion of the United States, while on its passage north it takes the ocean-route. This latter course is well authenticated by the remarks of that observant naturalist, Mr. J. L. Hurdis, in "The Naturalist in Bermuda," who gives the testimony of several well-known masters of merchant vessels, in regard to the vast flights of these birds met with at sea during their several passages from Nova Scotia to the West Indies during the month of September, in various years.

Their arrival in the West India Islands is also clearly established by the same authority. The island of Antigua is annually visited about the beginning of September by countless multitudes of plover; and on one occasion they made their appearance in such multitudes in St. John's, the chief town of the colony, that the inhabitants were seen in every direction shooting them from the doors and windows; indeed, so numerous were they, that boys destroyed them with sticks and stones, and shooting them soon ceased to be considered sport. They remained in the island for ten or fifteen days only, taking their departure south as soon as the weather became settled. The island of Martinique is also visited by amazing numbers of these birds. In Barbadoes, during a south-west gale, on the morning of the 12th September, 1846, these birds were so numerous that they were struck down with stones, and thousands were shot. Mr. Hurdis considers that after visiting the West India Islands, the plover finally settle down for the winter months in Venezuela and Guiana, and other northern portions of South America.

I have alluded, at the commencement of this paper, to the effect of gales of wind upon the arrival of birds at particular

positions, where they otherwise are rarely, if ever, observed; and I cannot omit to notice, in connection with this subject, the unusual opportunities afforded me and my brother naturalists, Major Wedderburn and Mr. Hurdis, while residing in the Bermudas, of observing the effect of wind storms upon various species of North American migratory birds. During the months of September and October, particularly the latter month, the vast numbers of birds, of very different species, which invariably made their appearance after a heavy gale from the north west, proved beyond a doubt, that while on their southern passage down the eastern coast of America, they became the sport of the tempest, and whirled hither and thither at its mercy, got at last happily cast upon the sunny isles of Bermuda, while thousands of their fellows no doubt met with a watery grave.*

Over 130 species of North American birds, never known to breed or even reside for more than a few days in these islands, have been observed at different times after heavy northern gales, and some of them which we know to be strictly boreal forms could not have migrated so far south of their own accord. The Snow Bunting (*Emberiza nivalis*,) and the snowy owl (*Strix nyctea*) are examples that might be added to.

During my observations both in Europe and America, I have found that occasionally a bird, perhaps of a different kind altogether, will accompany a flock of other birds on their migration, and live with them on the best of terms. Such birds, termed "stragglers," generally prove to be the greatest rarities, for it must be by the merest accident that one solitary bird manages to get separated from its kind and travel perhaps thousands of miles to a country perfectly foreign to its accustomed habitat.

Of the rarer birds of Nova Scotia, which up to the present time have come under my observation, I may mention the following:—

Great American White Egret, (*Ardea alba.*)—Of this magnificent bird I only know of one specimen having been ob-

* Many birds on landing in the Bermudas are so weak that a person may take them with the hand.

served in Nova Scotia, which was shot in the summer of 1867, on the shore of Halifax Harbour, and is now in my collection.

Snowy Heron, (*Ardea candidissima.*)—Although not so rare as the former species, it may be considered uncommon, as I believe there are few recorded instances of its capture. A very fine specimen was shot by Mr. George Drillio, of Halifax, some few years ago, in a marsh up the country.

King Eider, (*Anas spectabilis.*)—This fine bird, which is common in the far north about Hudson's Bay and the north coast of Labrador, occurs but rarely on our shores. The only specimen that has come under my observation was shot in March, 1863, near Halifax Harbor, and was kindly presented to me by Mr. J. R. Willis. It was a male bird.

Curlew Sandpiper, (*Tringa subarquata.*)—On the eastern coast of America, this bird ranges from Labrador as far south as Florida; but it appears to be but little known on the Nova Scotian coast, and may be classed among our rarer species. Dr. Bernard Gilpin, of Halifax, kindly forwarded me a specimen that had been shot by his son at the mouth of Halifax Harbour, in September, 1868.

Pectoral Sandpiper, (*T. pectoralis.*)—This species may be considered rare on our coast, although much more common than the former species. It is found as far south as the West Indies. I am also indebted to Dr. Gilpin for a specimen of this bird.

Schinz's Sandpiper, (*T. Schinzii.*)—This northern species, which, however, is found occasionally as far south as Florida, is another of our rarer sandpipers. Like as is the case with the former species, a few stragglers join the flocks of common sandpipers on their migrations up and down the eastern coast of America, and thus fall to the gun of our shore sportsman.

Art. IX. Notes on the Weather at Halifax, N. S., during the Year 1867. By Frederick Allison.

In this, the first paper which I have the honour to read before this Institute, I have endeavoured to keep close to a review of 1867, without exploring bye-paths leading to subjects which might tempt one beyond ordinary limit—subjects requiring *more* full treatment than I could give them to-night.

The plan followed in observing the several features of the weather, described below, has been this. Cloud is classed by figures from 0 to 10, the former being a perfectly clear sky, the latter complete cloud. The intermediate numbers being so many tenths of the sky obscured. The mean temperature of each day is calculated from 12 observations, read from a Negretti and Zambra Thermometer, placed five feet from the ground. with a N. N. W. aspect, and always in the shade. This thermometer has been satisfactorily tested in water just at the point of freezing, and is frequently compared, to ensure its continued correctness, with two other thermometers similarly tested; and which, under the same conditions, mark alike. The 12 observations are read directly from the thermometer, except those at 2 a. m. and 4 a. m.; which, with the aid of the Minimum Register, and the midnight and 6 a. m. readings, can safely be set down at an estimated point so as to be taken into the calculation of the Mean. Some observers do, for convenience sake, take observations at 7 a. m., 2 p. m. and 9 p. m. only, and calculate the mean from these, which give, on ordinary days, a very close approximation to a more elaborate calculation. But it is evident that on days with abnormal changes of temperature this plan runs a great risk of being erroneous. The minimum of the 24 hours is read from a Negretti and Zambra Thermometer, with self-acting Register in spirit, placed as above mentioned. The Maximum read in the usual way. During the year immediately under consideration this evening, I could only mark the number of *hours* of rain; now, through a friend's kindness, I have an accurate rain guage, of the simplest, and, as I believe, the best kind. Wind is noted, as cloud also, at 7 a.m., 3 p.m. and 11 p. m. The direction of wind is taken from an ordinary vane, but the force I have to estimate from observation and

practice, 0 being a calm, and rising through the regular classification to 10, which would denote a hurricane. In absence of an anemometer these observations of wind can only be taken as *generally* correct. The barometer which I formerly used, being out of order, I was not able last year to observe the pressure of the atmosphere. With this instrument again, I have found these of least complicated construction to prove the best, where you read the pressure from the simple tube. In the clock-faced kind, the hands of the dial are apt to get out of order, through a rusty pivot, or other cause. For the comparisons between Halifax and Windsor, I have been indebted to the kindness of my good friend Dr. Heusley, who placed at my disposal the result of the observations at King's College, made by himself and brother Professors between 1857 and 1864. From others in different parts of the Province I have derived much valuable information regarding phenomena, at different periods, and especially as to the opening of blossoms, ripening of fruit, &c., from year to year. But I hope to see the day, when, at least through Nova Scotia, we may have a regular system of weather stations, conducted on one plan; and a head station, where all the reports may be digested, compared, and shaped in monthly review; and also to be in constant communication with the other portions of this Dominion and the States of the neighbouring Republic. The benefits of this system have been so well proved in Great Britain, and the Continent of Europe, that from me no remarks upon its utility is necessary. The advantages gained from forecasts, by commerce and agriculture, have been widely acknowledged, even while, with the data at their disposal, observers stand but at the threshold of a science, which time, accumulating facts in its yearly course, must of itself complete. But I was lately struck by an instance, to me a new one, of their utility. A photographer told me that, although his business was not very large, he could probably save from ten to fifteen dollars for every day of the many he was now deceived by threatening mornings, preventing him from preparing plates for customers; or by clear mornings inducing him to prepare for a good day's business, and presently the cloud and rain left on his hands his morning's work altogether spoiled. These frequent

mishaps could to a great extent be anticipated, by signals giving the probable coming weather.

I now propose to take up 1867, month by month; always mindful that in this country where our stock of statistics is as yet so scanty, our first care should be to add to the mass, so as to form a foundation for future calculations.

January was on the whole a fine month, but we had some heavy snow storms, and an extraordinary depth fell notably on the 6th, 17–18th, 21–22d and 26th. I measured after the different falls an aggregate of 40 1-4 inches, which is more than twice the usual depth as I have noted it either here or in Windsor, in any other January. The steady cold preserved the snow, and the sleighing, which was at least tolerable on every day in the month, can only be equalled by 1866, when it was even better. But 6 hours rain fell in January, viz., on the forenoon of the 22nd. The mean temperature 19°.10 was 3°.22 below the corrected mean of the 5 years from 1863 inclusive, and it is worth remarking that of these five, each succeeding January has been colder than the one immediately preceding it. The range of temperature was very limited and the maximum but 37°. The minimum being 9°.3 below 0. N.W. wind, as usual prevailed, but the mean force was excessive, rising twice to a gale, and frequently blowing very strongly, generally with (or just after) snow. The temperature fell below 0 four times; but the month was more remarkable for *continued* than *extreme* cold.

February was very free from cloud, more so even than 1866, which was clearer than ordinary. The latter part of the month was particularly fine, and steadily cold after the 17th, which brought down the mean temperature considerably, the weather having been mild from 1st to that date. The mean 25°.11 varied little from that of 1863–67 inclusive, which is 24°.24. Both the maximum, 53°.1 and minimum 2°.4 were high, making the range of temperature much as usual. A great deal of rain fell on 10 different days, while snow was very deficient; the total being 3 1-2 inches. I notice that in 1866 there was a like want of snow in February. The prevailing wind, N.W., though frequent in February is generally surpassed by S.W. The

force was extreme, never being equalled by any month that I have recorded since May 1857, either here or in Windsor. A beautiful display of Aurora Borealis on the night of the 8th was followed on the 9th by a high S.W. wind, rising to a gale about 5 p.m., and continued till midnight of 10th, at times blowing very heavily, darting from S.W. to S. and back; finally settled through W. to N.W., and broke on the morning of 11th, when the temperature which had been high fell quickly to only 5°. We had 11 days sleighing, but mostly bad. The mercury was below 0 on 2 days. A Lunar Halo on the 12th was followed by mist, drizzle, and mild rain for the greater part of two days.

March 1867 was rather clearer than usual; but we had three snow storms, besides considerable snow in other lighter falls, reaching altogether the great depth of 27.41 inches. Rain was very scarce. The maximum temperature, 50° 4 was low, and the minimum high. The thermometer never marking below 6°, being a range of but 44°. However, though extraordinary cold was absent, a steady low temperature reduced the mean of the month to 26.94 which is over 1° below the mean of March since 1863, and a figure seldom reached in this month. But one day, the 27th, passed without frost. N.W. wind prevailed, which is common in March, though scarcely more so than N. or W. In this month the winds are very variable. The mean force was again extreme; only being equalled by last year, but though the winds were brisk and strong almost continually, they never rose to gales. Gentle snow showers fell during a partial eclipse of the moon on the night of 20th with a light W. breeze, and during the day the wind passed slowly through N. to N.E. There with some trifling variations, it remained till the night of the 26th, the weather being dry during the whole period, when rising very high from S.E. we had on the 27th a warm rain, followed by a long succession of snow, and cold rain, in storms and squalls, for many days. There was sleighing, generally good, from 3rd to 21st, which was the last of the season. Robins were seen near Windsor on the 23rd, but did not appear generally in the open fields either there or here till the 5th of the next month, or about the time that they are usually heard first. Snow drops blossomed at Windsor on the 30th.

April was a very wet month—much rain falling on many days, interspersed with snow storms, which latter reached a depth of 9 1-2 inches, being much more than usual. The temperature did not exceed 61°.2, which is a low maximum, and the minimum 17°, was extremely low, especially when we remark that it occurred as late as the 14th. The mean temperature, 37°.63, was nearly 3° below 1866, and 6 lower than 1863–7 inclusive. The customary N. wind prevailed, and the force continued very great, rising to a gale on the 19th, driving into drifts some four inches of snow which had fallen during the previous afternoon and night. The weather for some days before this had been very stormy; a southerly rain-storm setting in on the 16th and continuing with scarcely any intermission till the change to snow just mentioned, the wind backing through E. to N. Pansies blossomed in Windsor on the 5th; and the crocus in Cornwallis on the 11th, and Windsor on the 15th, and smelt were caught in the Avon on the same day. On the Saturday before Easter, the 20th, I picked full blown mayflowers in the Tower woods, and on the same day they were picked near Windsor, some 10 or 12 days later than usual. Frogs were heard at Spa Spring, Windsor, on 21st, and 23rd near Halifax. Dent de Leon in full leaf 26th. Thunder and lightning were noted about midnight between the two warmest days of the month, the 22nd and 23rd.

May was a very cloudy month, and well sustained its reputation for moisture; 20 of its days being marked as wet. No snow fell, however; the last of the season coming here mingled with rain on the night of 28th April. The thermometer ranged over 48°—from 71° 2 to 23. The maximum was unusually low, and I have no record of so low a figure as was attained on the morning of the 5th, 23°. The mean temperature 47°.86 was 31 above the five years, 1863–67; S. E. winds prevailed, which though often blowing at this time of year, are generally outnumbered by north winds. The mean force was still very great, but no gales; nothing beyond the very high wind which accompanied the rain-fall on the last day of the month. Daffodils blossomed on the 3rd, and asparagus was fit to cut on the 17th. On the 28th the narcissus was in flower, and the cherry was not

in full bloom till the same day, one week later than in 1866, and two weeks later than in 1865. Pear blossoms were not so much behindhand, being well opened on the 30th—9 days later than in 1865, but one day earlier than on the same tree in 1866. Though, as mentioned above, no snow fell in Halifax during this May, there were squalls over the higher lands in the interior, and the hills were whitened and remained so during the 19th and 20th in various parts of the Province.

The month of *June*, generally one of the most dry in the year, was in 1867 by no means so. Rain fell, and frequently heavily, on 16 days; but there was also much bright sun, reducing the mean cloud to a small amount. The mean temperature 58°.71 was lower than the usual mean for June in Halifax. Taken by itself, the month was on the whole, a very favourable one for farmers, though in conjunction with preceding and succeeding weather, the usual dryness of June would have been more profitable. The maximum temperature was scarcely 77°, remarkably low; and on the 11th the last frost of the season occurred, the mercury barely touching 32°. In 1866 there was no frost in June, but the event is by no means uncommon. South wind was most prevalent, exceeding slightly the usual S. W. The mean force was great, and we had some very high winds, but no gales. Lilies of the valley blossomed in a favourable spot near Windsor on the 1st, and at Gorsebrook on the 5th. Apple blossoms were fully out in Windsor on the 5th, and here on the 9th. The double cherry in Windsor on the 7th, in Halifax Cemetery on the 12th. The horse chesnut also in full bloom here on the 12th; having come out in Windsor on the 8th. The lilac flowered in Windsor on 10th, Halifax 14th. The Kamschatka rose in Windsor on 12th, honeysuckle 13th, and Pon Pon rose 15th; on the latter day the first shad was taken in the Avon. On 18th the hawthorn blossomed in Windsor, 23rd in Halifax. On 22nd wild strawberries were plentiful there; here not till 29th. In Windsor the yellow rose was in full bloom on 23rd. You will notice that these flowers and fruits were all four or five days earlier in the valley of the Avon than on the shores of the Atlantic; and in so far as my statistics yet denote, they were about six days late on the whole. The

earlier blossoms being a greater distance behindhand, and the later ones, as the month progressed, gradually gaining up to their usual period, and in some instances fully reaching it. The shad seldom vary more than a day or two, and in 1867 put in an appearance in the Avon on their usual day, the 15th.

July. I have never recorded, nor have I heard any mention of so wet a July as that of 1867. Rain fell on 22 days, covering in all over 143 hours, and from the 15th to 31st but one entirely dry day occurred. The 4th, 13th and 26th were very wet days; and the violent storm of 18th, 19th, 20th and 21st was a rare event in midsummer; during these days the wind shifted uneasily between S.E. and N.E., dwelling at times due E., and on the 20th it rose occasionally with the force of a gale, and the temperature became much diminished. The whole month was rather cold. The mean temperature 61°.92,—maximum 87°3 and minimum 46°, the latter a very low figure. W. winds with still great force prevailed; though E. N. E. and S. E. were more common than usual. Three times at night was thunder heard and lightning seen; never were either very near. After a light shower on 16th, a beautifully defined double rainbow was seen opposite the setting sun. It was just one week before we saw the sun again; the storm noticed above occupying great part of the intervening time. Green peas were picked in Windsor on 2nd, and were in market here on 4th. The moss rose blossomed there on 9th, and cherries were ripe on 12th. New potatoes of a good size were dug in Halifax on 14th. The raspberry ripened in Windsor on 23rd, currants on 25th, and dahlias bloomed on 26th. Ripe blueberries picked near Halifax on 31st. These dates agree very closely with those of 1866, but average about 10 days behind 1865, which for most fruits was an early season.

The season still continued very moist. Though *August* had not quite so many wet days as the earlier summer months, I am sure the quantity, could I have measured it, would have proved largely in excess of the mean fall for the month. Two bright terms and several detached dry days kept down the average of cloud close to the usual amount. It was a hot month, 4°.56 above the mean of 5 years; and on the 10th the temperature

reached 88°, a rare height in Halifax. This was a very warm day, the mean being 73°.84, and with the three preceding, formed the hottest period of the summer. The minimum, 47°.2, occurred on the 1st, and the first and the last days of the month were the coolest two days. High winds and strong breezes were still frequent; and the terrific gale from S., from about midnight on 2nd to 7 on the morning of 3rd, blew with a force fortunately not often known in this latitude; many large trees were uprooted throughout the Province, and damage done to buildings, fences, &c. We had had showery weather with brisk S. E. breezes for two days previous, and on the afternoon of the 2nd the wind veered to S. with fog; during the evening backed to S. E., and very thick. At 11 p.m. there was a high wind, but the real gale rose very suddenly, chopping quick from S. E. to S., as far as I could judge, the greatest strength seemed to be from 2 1-2 to 6 a.m. Heavy showers fell about the latter hour, and by 7 a.m. the force had abated, though a very high S. wind lasted nearly all day, succeeded by another foggy night and showery forenoon, with wind from S. W. at times very high. On the evening of the 4th this thick and stormy weather at last ceased, and a rainbow appeared, a herald of warm dry weather, which set in for several days. On 8th lightning was reflected in the West. 7th the musk melon ripened; 9th gooseberries, and 17th blackberries. The Madeline pear was ripe in Windsor on 19th, and on 22nd the ordinary harvest apple, also in Windsor. Nectarine plums were picked on 23rd, and the Maiz or Indian Corn in Windsor on 28th, and here I heard of it on 29th.

September was not as wet a month as in 1866, but still more so than usual: much rain falling especially during the last week. Many bright days, however, made about an average amount of cloud. The maximum temperature, 81°.7, was reached twice; viz., on 6th and 9th. The minimum was 33°.6; but thrice was there frost on the grass; the first of the season was on morning of 12th. The mean temperature 57°.95, was within 3-10 of the last September and 1-10 of September 1865, and very close to the mean of five Septembers. N. W. winds were prevalent with a mean force below that of any other month in the year. The

20th, 21st and 22nd passed with fine dry weather with cool nights; a little rain fell on the morning of 23rd, and that evening a beautiful band of auroral light more plainly seen on the 24th, was followed by much stormy weather continuing into October. The month ended with a violent rain fall, and a N.W. gale that evening accompanied the wintry weather which then we were entering upon. The "Maria" pear was picked in Windsor on 9th, and the "Bon Cretien" 13th; "Washington" plums 12th, and green gages 18th. These fruits, as those of August, were about eight or ten days later than usual, and two to three weeks later than in 1865.

October as a whole was neither very clear nor cloudy, but its division of wet and dry days was very unequal. Out of 14 wet days 9 occurred before the 14th of the month, and many of them were very wet. Again from the 17th to the end of the month but 5 wet days are found, and but one storm. The rain mentioned on 30th September changed on 1st October to snow, and for four hours in the morning, and nearly as long in the afternoon, the flakes came down briskly, well whitening the grass and house tops. In many counties from 4 to 6 inches fell, according to report. The mean temperature 45°.60, though slightly in excess of 1866 or 1865, is scarcely equal to a five years average which I calculate at 46°.32. The range was not great, being from 68°.8 to 25°.9. The mean force of wind was above the average. The prevailing direction N. W., not a very common wind in October, W., N., or S. W. being generally more prevalent. A notable rain storm on the 11th, 12th and 13th, was accompanied on the morning of the second day by a S. E. gale. Rain fell at that time for 37 consecutive hours. Water was first frozen on 4th, when pools were skimmed with ice. Capiauman and Cycle Pears thoroughly ripe in Windsor on that same day. In 1866 Capiaumans were picked ripe from the same tree on September 27th, and in 1865 on September 16th. We had thunder and lightning on afternoon of 22d, but neither loud nor vivid.

Dry weather in *November* was very rare; but once had we two consecutive days without some rain or snow; and only seven in the whole month. As a consequence cloud was in excess of

the mean. Rain storms occurred on the 4th, 11th, 16th, and 30th, and 5 1-4 inches of snow fell in this month. Since 1857 I have no record of so much snow in November, except in Windsor in 1859, when 6 3-4 inches fell. On the 20th, 21st, 22nd and 23rd, there was tolerable sleighing in the city. In the N. E. of this Province, and the central counties of Colchester and Hants, there was good sleighing on the 15th, and it lasted twelve and thirteen days. A very unusual occurrence. The mean temperature, 36°.60, was very low; and a great degree of cold for the season, 13°, was reached on the 20th, while as early as the 7th the thermometer marked before sunrise but 14°. 59° was the maximum, giving the wide range of 46°. This, again, was a windy month, and some damage was done by a strong gale on the early morning of the 3rd, swinging from N. W. to S. W., following four showery days, and preceding a rain storm with high S. E. and S. winds. Another gale rose as the storm of 30th cleared, and blew fiercely from W. during the last hours of the month. Many ponds in the neighbourhood of Halifax bore well on the 8th, and good skating was general on 19th. Once more were we disappointed here in the great meteoric shower, which was visible generally throughout America and Europe. For six days before the looked-for 14th fog and thick cloud, rain and snow had obscured our skies, and, though a partial clearing on the very afternoon excited some hopes, night closed in dark and wet, and the opportunity was lost.

December generally the most cloudy month of the year, was wanting in 1867 in that characteristic. Detached showers were most common, and though parts of many days were bright, we escaped without rain or snow but on 6. The snow fall was most extraordinary, 27 1-4 inches, against an average of but little over 10. On 23 days we had sleighing; but the snow came generally in small amounts, the only fall of any consequence being on 20th–21st. The maximum temperature, 43°.4, was very low, and in every year that I have recorded has risen above that. The minimum, –7°.9, was lower than I have ever observed in Halifax; but in Windsor, on Christmas Eve, 1865, the thermometer marked –8°, and on 21st in 1862, –7°.5. But the most remarkable result of this month's record is the exces-

sively low mean temperature, 18°.52—9°.36 below December 1866—nearly 5° below the mean of three years in Halifax, corrected to 1867, and nearly 7° below this month's mean from 1857 to date in Halifax and Windsor; in other words a deficiency of heat within a small fraction of 28 per cent. N. W. is far the most prevalent wind in December, but this year there was more W. wind, and generally greater force than is usual. But once, however, it rose to a gale—S. to S. W., with warm rain. The Dartmouth Lakes bore well on the 5th. Temperature was at or below 0 on 5 days, viz.: 9th, 12th, 20th, 30th, 31st. I have no record of its being so more than 4 times in any previous December, and the average for eleven years is only twice. I never knew the temperature below 0 earlier than the 12th till this December, when it fell to 2° below on the 9th.

Review of the Year 1867.

In bringing together the results of the observations, the chief of which we have just run over in monthly notes, the following phenomena stand out most prominently from the year's collection. There was less cloud than usual, although the year was a remarkably wet one throughout, with the exception of late summer and early autumn. Rain or snow fell on 222 days, but many storms occurring, and showers, often clearing rapidly, left room for the brightness already alluded to. Much more snow than usual fell. In January, March, November, and December we had a great deal; and the woodman's work, and all traffic on the roads was much facilitated by the long periods of good sleighing. Though the summer was very wet, and the rains of July damaged much hay, the comparative dryness of August, September, and October saved the later crops, and much fruit was gathered in good condition, and often in abundance.

The mean temperature of the year was 41°.98—being .89 below 1866, and .85 below the mean of the five years including the one under consideration. August was the only month of remarkable warmth; and February was decidedly above the average, but the remaining months were mostly more or less deficient in heat; and January, March, June, November, and

December extraordinarily so. The thermometer marked from 88° on the 10th of August, down to –9°.3 below 0 on 30th and 31st January—a range of 97°.3. High winds were frequent throughout the whole year; and, though for lack of an anemometer, I am obliged to estimate the force by observation, each month would probably show an excess if measured. The notable gale of 3rd of August I have already fully mentioned under that month's record. Dividing the winds, as regards their direction, into two grand divisions of westwardly and eastwardly we find 232 of the former to 91 of the latter to be the most prevalent on so many days; or in other words, westward winds exceeded eastward winds in the proportion of rather over 2 1-2 to 1, or 155 per cent.

There were 87 days sleighing in the year. Hoar frost formed on 32 mornings.

The Aurora Borealis was visible on 32 nights. That of the night of 8th February was a beautiful sight. The flickering streams of light now horizontally waving, and now quickly darting upwards, shooting forth as it were coloured tongues of pinkish, greenish, and almost yellow hue; and on the 4th of May, besides a faint display of pale auroral light to the north, a bright band sprang glistening from almost west to the zenith, varying in breadth and distinctness during the evening. While I will not pause here to consider the different theories as to the cause of the phenomenon which we term Aurora Borealis; none of which, I presume, may be called conclusive; I may state that in looking through eleven years of almost complete observations, either here or in Windsor, I have found this luminous appearance to be followed in winter by falls of snow or rain within twenty-four hours, three times out of four. In spring and in autumn dry or wet weather follows in equal proportions. In summer, out of thirty observations twenty-one gave dry weather, frequently continuing some time, and nine gave wet—rather more than two to one in favour of the former. The probability is that we should refer this phenomenon to no one cause, but to a combination producing the conditions adapted to its appearance. This would form of itself an interesting subject of consideration.

11 times the temperature fell to 0 or below.

11 gales were noted.

A remarkable Lunar Halo on evening of 12th February, as observed in the record of that month.

But twice did thunder storms occur.

On 42 days there was fog.

On 183 days we had frost. The longest period that it was absent was from 11th June to 12th September; the earliest four viz: 12th, 15th and 24th September, and 1st October, read from ground thermometer. This harbour was open throughout the whole year. I notice that in the proceedings of the Institute, your late esteemed and worthy member Col. Myers, reviewing meteorologically the year 1866, says, while noting as remarkable the fact that the harbour freze over with a temperature of 7 below 0 on 7th February, but did not do so on 7th January at 15 below 0, that "it must be borne in mind that a combination of wo conditions of the weather is required, viz.: a perfect calm with a certain low state of the temperature, without which the harbour does not freeze; and to this may perhaps be attributed the infrequency of what was witnessed last winter." Now, no doubt this is true, and partially accounts for the event; but we must also remember, that up to a certain point, before the sun has again attained any great height, the water itself is giving off its own heat, and later in the winter there is not the same resistance in it to be overcome, that there is at an earlier date when the effects of the heat of the past summer are comparatively recent; and therefore from this cause alone, *cæteris paribus*, a a large body of water in motion would freeze at a higher temperature of the atmosphere in February than in December; i. e., it would then be more readily assimilated to that atmosphere in its own temperature. The same holds good with the land; and is indeed the chief reason why we do not, as a matter of course, experience our greatest heat when the sun's rays are most nearly vertical, in June; and the contrary in December; whereas we all know that our maximum of heat is most likely to occur full a month after the longest day, and our minimum as much after the day when the sun is lowest; so that the sun's rays and the earth's surface acting together upon the atmosphere,

join to produce the warmest period at a season when, by the orders of an all-wise Creator, doubtless it is the most useful; and as well to bring the greatest cold when its benefits also may be most suitably bestowed. A marked and most interesting instance of the effect of this reception and discharging of heat, both by land and water, may be observed in Cuba, and other tropical Islands. For months together the phenomena of sea and land breezes occur daily and nightly. Between about 8 and 10 a.m. may be noticed a dead calm; gradually (the water being less heated than the land) as the power of the sun's rays increases, a breeze, at first gentle, and by noon strong, blows in from seaward, and continues till late in the afternoon, falling towards sunset, and dying away completely by 6 or 7 in the evening; a short lull occurs, but soon puffs of wind off the shore are felt, and night has scarce fallen ere a steady land breeze is blowing, ceasing as the sun again rises, to the calm first mentioned, to be followed as before, till causes outside of these disturb the rotation; as happens more frequently from midsummer till the end of autumn. We know then that both land and water have a certain amount of heat to be overcome, and here we see the land more sensible to the changes of the atmosphere than the water, and the draft of air setting always from the cooler to the warmer; leading us on to a consideration of the laws which the currents of our atmosphere follow, but which I will not attempt to enter upon at this time.

Art. X. On the Fishes of St. Margaret's Bay. By Rev. John Ambrose.

The Turbot.

The mere announcement of the name of this fish will cause the English Apicius to prick up his ears. Long has it been cast in our teeth that our extensive list of food fishes is sadly incomplete, seeing that it includes neither the turbot nor sole. In vain do we endeavour to draw off attention from this want, by pointing to our luscious halibut, which could not have been con-

tained even by the large pot specially recommended by the courtier Montanus, to the Emperor Domitian, for the accommodation of his extra-sized turbot. And, alas! for us, we have not the art possessed by certain cooks of ancient times, who could make a turbot or an ortolan out of hog's flesh. In our earnest desire to satisfy our British visitors, we may sigh in vain for the wonderful skill of the cook of Nicomedes, king of Bithynia, who when his master longed for a John Dory when he was at a distance of three hundred miles from the sea, supplied him with a fresh one within the hour. But, after all, better perhaps than the lost art of counterfeiting turbot, is finding the Nova Scotian namesake of the real Simon Pure in our own waters. There is a fish of this name, rather plentiful in the deep muddy ravines—the home of the hake—off the mouth of our Bay. This fish is considerably larger than the flounder, and readily takes the bait thrown for cod, when the latter fish is not at hand to drive away his mud-loving neighbour,—and a sure sign of the scarcity of cod at any particular spot, is one of these turbot on the fisherman's hook.

Our turbot, when full-sized, are about two feet in length. They are always caught in deep water, say from 30 to 60 fathoms.

The Flounder, (*Platena plana*,)

Abounds on our coast, and a very nice pan fish he is. He spends the winter in moderately deep water, protected from the frost, and finding abundance of food in the muddy bottom. But when the sun's power begins to be felt in the spring, the flounder—with almost all the rest of our common shore-fish—comes into shallower water, for light and heat are both required for his summer-life and its occupations. No fear has he of the cruel spear which first stirs up the mud to attract his attention, and excite his hopes of a tit-bit, and the next instant transfixes and brings him helplessly flapping to the hand of the boy-fisherman, whose basket is soon filled for the clamorous swine. It is hard to say who may be the enemies of the flounder during winter, but one—the loon (*Colymbus glacialis*) is at that season frequently shot with flounders in his crop.

On first approaching the shore in spring these fishes are full of spawn, but they begin to deposit it in April. By the end of June the work of spawning is accomplished. Their food during winter—judging by the contents of the stomachs of such as are brought up from the mud on eel-spears—consists of eel-grass and fine silt. Towards spring, as they become more active, they burrow for sea-worms. But when once in shore they are ready for the offal of the fish-stages, and assist in disposing of much waste matter.

The Eel.

As is well known, spends the winter in the mud. At first, on the approach of cold weather, they burrow pretty deeply, and live on suction from the surrounding mud. Towards spring, they feel the relaxing temperature, and perhaps becoming hungry after their long fast, work up a little towards the looser mud, and pick the succulent roots of the eel-grass. They leave the mud altogether, about the first of May, and approach the light and heat of the shore. Their favourite haunts in winter are the coves into which the fresh water of some river or brook mingles with and renders slightly brackish the waters of the sea. In such places, probably, the silt of the bottom is charged with a larger quantity of animal matter, besides being the proper *habitat* of the eel-grass.

Eels of the same species differ much in their habits. They go up the rivers and brooks in the spring, and return to the salt water, for warmth, probably, in autumn. But many remain in fresh water all winter, burrowing in the muddy bottoms of the lakes. In Hosier's river, near my residence, in March last, two men speared in one day fifty dozen large eels. These were not found to be so palatable as the eels taken in salt water at the same season. Altogether, from the same place in the river, some eighteen hundred eels were taken, so soon as the unlooked-for discovery of this new spot became known.

In the semi-annual migrations, many eels are taken in weirs, in our streams. This is considered rather destructive; but one has but little pity for a fish that devours so many of our young salmon.

Our shore-people have none of that squeamishness which excludes eels from the tables of our inland population. When once the ice has become sufficiently strong to carry a man over the eel-beds, not a fine day in winter passes without seeing a party of eel-spearers at almost every muddy-bottomed cove around the Bay. There, standing on two or three spruce boughs to keep his feet off the ice, but often regardless of cold feet, stands the patient and laborious fisherman, darting with both hands his spear, by its long slender handle, into the mud below. Ten or fifteen dozen eels in a day are considered good catch, though if one does not happen to strike a good spot a man may not catch more than two or three, as eels are gregarious, even in their winter quarters. Many years ago eels were much more plentiful in the in-shore mud-banks than now,—for of late years their haunts are so torn up by the spears, that the eel-grass is not nearly so abundant as formerly.

Eels are much more delicate in winter than in summer, when they live on garbage and become very fat. In the warm days of July and August, they thoroughly enjoy themselves, basking in the sun, as they lie on the bent tops of the floating eel-grass, at half tide or low water. They also hang perpendicularly, mostly with the tail, but occasionally with the head downwards. Then the keen-eyed fisherman, from his boat, detects his prey, invisible to the uninitiated, and secures the writhing victim between the tenacious jaws of his wooden spear. A great many also are caught in eel-pots of wicker-work, into which they enter, like rats into the funnel of a cage-trap, and—once in—cannot get out. These pots are baited with squid, when they can be had—as this is the favourite food of the eel,—but more frequently a crushed lobster is placed within as the *attrait*. The pot is then sunk by attaching a rock to it, and, after a reasonable time, is hauled up, often well-filled with the squirming prey.

Bobbing for eels is seldom practised here. One summer's afternoon, when a boy, I caught a large number of fine fat eels in the flood tide of the coffee-coloured Shubenacadie, near Maitland, by the very simple plan of wading into the river to my knees, holding the bait on the muddy bottom with one hand,

and allowing the eels as they came, to pass their heads between the thumb and fingers of the other, thus grasping and throwing them ashore as fast as they came to hand. It is a little surprising that, even if the people living on the banks of the Shubenacadie cannot bring themselves to enjoy the luxury of eating these excellent fish, they do not take the trouble to catch and sell them to others less fastidious than themselves, and more able to appreciate the good gifts of a bountiful Providence.

Eels do not always confine themselves to the rivers, bays, or inlets, but are sometimes found outside of the shore range in the Atlantic itself. Mr. Charles Richardson, of Indian Harbour, as well as several others, testify to having caught them tangled in their herring or mackerel nets, two or three at a time, at a distance of two miles from the coast line. Perhaps, as the in-shore beds become too much disturbed by the spears, and denuded of grass roots, eels—with the sure instinct of self-preservation—venture out to the oozy and worm-charged gulches of the ocean, where no spear but the trident of Britannia can bear rule.

Our fishermen greatly wonder at the secrecy of re-production among these fish. They say that although they catch them at all seasons of the year, they never by any chance find either spawn or young eels in them. But, after all, there is a season immediately after the breaking up of the ice, and also on the point of its first formation, and before it is strong enough to carry, when eels are not caught here.

I have remarked that many eels go up the river in spring, and return to the sea in autumn. This is easily proved at Mill Cove, on the western side of this Bay, where a high mound or dam of round beach-stones crosses the outlet of a lake at high water mark. Here at the seasons mentioned, these fish may be seen in large numbers all travelling in one direction among the wet stones from the sea to the lake, and *vice versa*. Large numbers are then taken by hand.

Our fishermen have a high opinion of the efficacy of eel-oil in removing the ill-effects of a sprain. For this reason they bind the skin of an eel around the injured limb. A small quantity of eel-oil dropped into the ear, is also one of their specifics for a recent deafness.

Eel,—Conger, leaves the deep water and comes about the stages and along the shores in April. They are neither so numerous nor so highly prized as the common sort. They burrow in the mud, in winter, like the others.

There is a sort of eel of very large size and great fatness—not short, like the conger, but proportioned like the common eel, which is found in a small lake on Gravelly Island, near Aspotogan, at the western side of the mouth of this Bay. These giants are occasionally to be seen lying in shallow water. At first sight they are often mistaken for large pieces of sunken wood, so still do they lie, but at the first touch off they dart into the dark depths of the lake.

Mr. Richard Daubin, of Peggy's Cove, some years ago was with a party of seven others, who were fortunate enough to see two of these large eels in Gravelly Island lake. The method of capture adopted was to fasten a strong codfish hook to a pole, and having cautiously brought their boat as near the eel as possible, to let down the pole gently and gaff him. This they did first to one the thickness of a man's thigh, but in a moment he broke the hook and was out of sight. However, having re-adjusted the gear, they were lucky enough to gaff another about the thickness of a man's arm, and after a hard tussle to get him into the boat. Part of his fat and *strong* carcass furnished all who chose to partake with a bountiful repast, leaving the remainder for another meal.

The Rock-eel is about 9 inches long, and is frequently seen along our shores. Its name is derived from its habit of keeping on rocky bottom—at least during summer. In winter it moves off into deeper water, but not so far as most of the others. Shell-drakes are often shot whilst fishing not far from shore, in early spring, with rock-eels in their crops. The rock-eel does not seem to burrow in the mud, like the common eel, or the conger, as it is never taken with the spear.

Some twelve years ago, when mackerel were very abundant along our shores, and large quantities of them were caught at Peggy's Cove, the water of the Cove became very offensive from the immense quantity of garbage which was thrown off the stages. All the rock-eels in the Cove died, and over the whole

surface of the nearly putrid water, these, as well as sculpins, flounders and cunners or perch, were continually rising here and there in a dying state. Flounders would run ashore on the flat rocks, half way out of water, and there remain to die. The clear sea water was but a short distance from the mouth of the little cove; but it would seem that these fish, like the drunkard, were not aware that they were being destroyed until it was too late to escape. The young pollack made their exit from the lethean pool in time, and not one of these prudent and self-denying young fellows was found among the dead. The *Teredo Navalis*, busily at work destroying the fisherman's stages, as usual, at last met his match. The poisonous water arrested his mischief, and soon closed his labours forever.

The water at that time must have been in a terrible state, seeing that any boat newly painted white, if brought into the Cove but for one night, would in the morning be found black below the water line, and lead-coloured above it, and no scrubbing could remove the stain, or restore the original colour.

I may here observe that the *Teredo Navalis* requires pure sea-water for its existence. Vessels or boats, moored in the mouths of rivers or large brooks, do not suffer from its ravages in this Province.

The Perch, Cunner or Rock-Fish.

This fish, having spent the winter a little off shore, comes in about the first of May. It spawns in August. It is most useful in clearing the coves of garbage, but although what might be called a coarse feeder, it has a particular weakness for the eyes of fresh herring. When a herring-net is moored with one end close to shore, in summer, almost all the herring meshed in the in-shore end, if left any considerable time in the net, are found to have had their eyes extracted by the perch.

Though, as I have just observed, perch are famous scavengers, the super-abundant offal twelve years ago in Peggy's Cove was too much for them. Many died, but of all the small fish in the Cove, they were the last affected.

Some perch always remain in the deep water outside feeding on the cod-grounds, in from thirty to sixty fathoms

of water. Many of these are of a red colour, and of a much larger size than their in-shore brethren.

I have enumerated perch among the edible fishes, because though used only as food for swine at St. Margaret's Bay, they are eaten in many other places, and are said to be very palatable when skinned and properly fried.

Some years ago in Portland, U. S., I saw a large pic-nic party leaving the wharf in a small steamer with music and flying colours, for an excursion down the Bay. The party, I found by an account of their excursion, afterwards published, was no other than the "Ancient and Honourable Fraternity of Cunners," and one source of amusement for the day was angling for and eating their finny namesakes. Happy days were these, before the terrible scourge of civil war fell upon that wonderfully prosperous country. Well would it have been for that people if innocent amusements had served as a sufficient outlet for their excitable temperament, and brotherly love had proved too strong for ambition and political animosity. Well will it be for us if we be warned by their example, and the sight of the wreck prove stronger than the voice of the syren. "*Nam tua res agitur paries cum proximus ardet.*"

Art. XI. On Submerged Forest Trees in Cumberland Basin. By P. S. Hamilton.

Near the margins of the head waters of the Bay of Fundy are found, in several places, certain accumulations which geologists have distinguished by the name of "submerged forests." One of the most extensive and most plainly visible of these is to be found near the head of Cumberland Basin, and has been carefully examined and geographically described by Prof. Dawson in his "Acadian Geology," page 32; but similar appearances may be seen elsewhere on the shores of Chiegnecto Bay, and also of Cobequid Bay and of some estuaries of streams emptying into Minas Basin. At the several places referred to, on the extensive slope of the flats between high water and low water

mark, there are found imbedded in the marine alluvium portions of trunks and also stumps of trees, the latter often remaining in their original position and resting upon the remains of upland soil, upon which they are supposed to have originally grown.

Great importance has been attached to these remains as evidences of a subsidence of the land generally in that section of the country where they are found. Dr. Dawson, with apparently no hesitation, utters the opinion that there has been a change of sea level here, the cause of which he says must be assigned to "either the rupture of a barrier previously excluding the sea water, or an actual sinking or subsidence of the whole western part of the Province." He believes that "a subsidence has taken place over a considerable area, and to a depth of about forty feet;" and this subsidence he supposes to have been gradual. Entertaining, as I most certainly do, a profound respect for so eminent an authority, I must nevertheless take the liberty of at least questioning this conclusion, and of expressing the opinion that too much importance has been attached to the appearance of these submerged tree stumps. I shall briefly give my reasons for doing so in this paper.

I am not aware that any evidences of a subsidence of the land in the Western, or Northern part of Nova Scotia, have been discovered, except these appearances at Cumberland Basin, and a few other similar localities. If these appearances can be sufficiently accounted for through other causes of a distinctly local character—causes which we may now see in daily operation, we may reasonably conclude that the subsidence is *not proven*. The action of the tides about the heads of the Bay of of Fundy may easily be imagined even by those who have never witnessed them. Wherever a vertical surface, whether of rock or earth, is presented to the tidal current, the bank so exposed is rapidly worn away by the great force of the current. The matter thus swallowed up by the water and held in suspension by it for a time, is eventually deposited upon the flats, or gentle slopes, over which the tides flow. It sometimes happens that the alluvial deposits thus made again undergo the same process. If we examine any of the channels intersecting the marshes formed by the Bay of Fundy tides, we shall find that,

throughout a large proportion of their length, there is a gradual change going on in the *locus* of the channel itself. On one side of it we shall usually find an abrupt bank of alluvial soil; on the other, a broad expanse of recently deposited mud, sloping gradually from high-water down to low-water mark. This bank is being constantly sapped, and its component materials carried away by the tide which, on the other hand, is as constantly depositing a corresponding quantity on the opposite slope. Thus, where artificial means are not taken to prevent it, the older marsh land is being daily engulphed whilst new marsh is being made; but, as of course, the upland banks and sandstone cliffs bordering the Bay and its estuaries are constantly being subjected to this same sapping process, the whole area of marine alluvial deposits is steadily and rapidly enlarging. As might be supposed from the great abrading force of the tides of the Bay of Fundy, combined with the effect of winter frosts in this climate, the work of disintegration and removal goes on rapidly among even the firmest materials which go to form the shores of the head waters of the Bay: these are the new red sandstone of Colchester, Hants, and Kings, and the soft carboniferous sandstones and shales of Cumberland Counties. Still more rapidly does this process go on where the shore happens to consist of a deep gravelly upland soil. To the existence of such soils at several localities on the margin of the channels of the Bay and to their rapid washing away by the tides may, I think, be attributed the appearances at Cumberland Basin and, elsewhere, which are supposed to be the remains of extensive submerged forests.

We find all the broader expanses of marine alluvium, or marsh land, about both arms of the Bay of Fundy, dotted with isolated patches of upland. These are called islands, even where they are not bathed by the water on any side; because of their island-like appearance as they uprear themselves above the sea-like level of the marsh. Some of these on the shores of Cobequid Bay and Minas Basin show, where sections of them have been made by the action of the tides, beds of new red sandstone covered with a deep layer of soil; but, for the most part, both there and elsewhere, after going beneath the surface soil, we

find them to consist merely of beds of gravel. Where not denuded of their growing timber, its prevalent varieties, especially where the gravelly sub-soil is found, are usually pine, oak, and birch, and often differ from those of the neighbouring main upland. These so-called islands vary in area from a few roods up to several hundreds of acres; and in elevation from 10 or 15, up to 60 feet above the level of the surrounding alluvium. They abound in the marshes of Truro and Onslow. Long Island and Boot Island, on the seaward margin of the Grand Pre are notable examples of them; and others are to be seen of smaller dimensions in the marshes skirting the rivers of King's County. We find numbers of them again in the broad alluvial plains of Cumberland and Westmoreland. In the midst of the great Tintamarr there is one which comprises several farm steadings; and there is another of comparatively large area near the mouth of the Missiquash, and but a short distance from the site of the submerged stumps described by Dr. Dawson. It is no part of my present purpose to discuss the question of how these islands were formed. I think, however, that the supposed subsidence of the western coast of Nova Scotia may be accounted for by the disappearance of one of them in the vicinity of Fort Lawrence ridge in Cumberland County.

I have already referred to the abrading force of the tides upon the banks of their containing channels. The rapidity with which the tidal current saps and removes the material forming those banks is very remarkable. Cobequid Bay forms in part the boundary between the townships of Truro and Onslow. Farmers now mow grass and make hay in Onslow on the identical spot where, within the memory of many persons still living, the same processes were carried on in Truro, the Bay having changed its bed to the extent of its whole width within so brief a period. This is unmistakeably proved at one particular spot by the fact that the remains of a breakwater formerly built in Truro have gradually become "annexed" to Onslow. It is possible that in other localities the tides have made equally great encroachments on the Onslow shore. Such being the case, where the shore of the Bay consists of a compact, clayey alluvium, it may easily be conceived that the abrading effect of the tide cer-

tainly could not be much less where the enclosing banks consist of a loose upland soil resting upon beds of gravel. If a proof of this were required, it might be found at Savage's Island, in Truro. This is one of those many isolated patches of upland already referred to, which lies upon the immediate southern margin of Cobequid Bay. In the old times of the French dominion in Acadia, the north-eastern and most elevated part of this island was consecrated and used as a burial-ground; and it is still so used by the Micmac Indians in that part of the Province. We may reasonably suppose that the old Acadian French would not bury their dead very near the brow of what must have been, even then, a steep, but no doubt wooded bank, exposed to the destructive action of the tides. At all events, that destructive action has been so great that so long ago as five-and-twenty years since, or more, many of the graves on Savage's Island had been opened at the bottom, and human bones were occasionally to be seen strewn down the steep bank where the undermining tide had produced land-slides.

Now, let us suppose that, some centuries since, there existed one of these gravelly and then wooded mounds, similar to others now to be seen in that vicinity, on the margin of the Cumberland Bason, at the most western extremity of the marsh which extends from the mouth of the Missiquash to the mouth of the La Planche. A glance at the map will show that on no other part of the shores of Chiegnecto Bay is the tidal current likely to strike with greater force than on this very spot. What would take place? The tide would gradually undermine the upland bank opposed to it. All the finer particles of earth would be carried away by the water. The coarser and more ponderous pebbles and boulders, if any, would sink to a lower level. Meanwhile the surface soil, being above the immediate action of the water, would still remain like a closely woven mat, held together by the intertwined roots of growing trees and the rootlets of grasses and other vegetable productions. Eventually this undermined and mat-like surface would slide, or drop, into the water in large flakes. The submerged turf would almost immediately collect a coating of mud from the overflowing tide; whilst the trunks of the still standing trees would be broken or ground

off, by the action of floating ice, the stumps and roots remaining embedded in the bottom of the Bason. This process, which may be witnessed on a small scale on the banks of any stream, would be continued until the whole hillock or island disappeared.

I believe that, in fact, this is what has taken place at the spot, off Fort Lawrence ridge, so particularly described by Dr. Dawson. This is only a conjecture, it is true: but it is one which seems to be favored by more facts than that other conjecture that there has been a recent subsidence of the whole western or northern coast of Nova Scotia. There are no evidences in confirmation of the latter view—at least none that I am aware of—except the appearance of these submerged tree-stumps and turf in Cumberland Bason, and in some other spots about the Bay of Fundy, where their presence can be still more easily accounted for upon the former hypothesis. These vegetable remains cannot be of very great age. We have continuous records of the history of Nova Scotia for over two hundred years. We may fairly assume that these forest fragments became submerged within that period. Had there been, within that period, any sudden subsidence of a large tract of country to the depth of forty feet, it would almost unquestionably have been attended with some very striking phenomena, which the inhabitants of the country could not have failed to observe, and of which they would have handed down to us some written testimony. Had there been, within that period, any subsidence, either sudden or gradual, to such an extent, we should surely find upon the coasts of the country numerous evidences of it which could not be explained away upon any other hypothesis than that of there having been such a subsidence. We have no such additional evidences. I therefore think that, for the present, we are justified in concluding that there has been no such subsidence, and that the instances of the submergence of forest trees, herein referred to, are local and exceptional, and are attributable simply to the action of the tidal currents in the Bay of Fundy.

APPENDIX.

METEOROLOGICAL RECORD

HALIFAX, NOVA SCOTIA, LAT. 44° 39′ 26″ N., LONG. 63° 36′ 40″ W.

1867.	Jan.	Feb.	Mar.	Apr'l.	May.	June.	July.	Aug't	Sept.	Oct.	Nov.	Dec'r	1867.
ESTIMATED MEAN CLOUD.....	6.2	5.5	6	6.5	7.4	5.1	6.8	5.8	5.5	6.	7.8	6.	Average 6.2.
PRECIPITATION.—Rain fell on.....	1 day.	10 dys.	4 dys.	14 dys.	20 dys.	16 dys.	22 dys.	15 dys.	15 dys.	13 dys.	18 dys.	7 dys.	Total 155.
Hours of Rain fall...	6 hrs	69.7hs.	20.3hs.	107.5 h	136.6 h	67 hrs.	143 hrs	105 hrs	68.7 hs	98 hrs	123 hrs	35 hrs	Total 979.8.
Snow fell on.....	22 dys.	9 dys.	15 dys.	10 dys.						2 dys.	10 dys.	22 dys.	Total 90.
Snow inches.....	40·2	3.51	27.49	9.46						Inapp.	5.24	27.3	Total 113.2.
Melted Snow inches.	3·21	.25	2.97	1.18							.63	2.81	Total 11.05.
*No. of Dry Days....	9	13	15	11	11	14	9	16	15	17	7	6	Total 143.
TEMPERATURE.—Maximum.....	37°	53°.1	50°.4	61°.2	71°.2	76°.9	87°.3	88°	81°.7	68°.8	59°	43°.4	Maximum 88°.
Minimum	−9°.3	−2°.4	6°	17°.1	23°	31°.9	46°	47°.2	33°.6	25°.9	13°	−7°.1	Minimum −9°.3.
Extreme range of M'th	46°.3	55°.5	44°.4	44°.1	48°.2	45°	41°.3	40°.8	48°.1	42°.9	46°	50°.5	Range 97°.3.
Mean of warmest Day.	32°.7	41°.1	40°.25	46°.22	59°.37	67°	69°.77	73°.84	69°.74	59°.9	53°.41	37°.4	Warmest day 73° 84.
Mean of coldest Day..	1°.3	4°.73	17°.11	30°	35°.66	48°.21	5°.55	57°.14	46°.59	33°.82	20°.37	0°.81	Coldest day 0°.81.
Mean of Month.....	19°.1	25°.11	26°.94	37°.63	47°.86	58°.71	61°.9	67°.82	57°.95	45°.6	36°.6	18°.52	Mean 41°.98.
Mean Daily Range...	13°.39	16°.29	15°.81	17°.3	18°.53	22°.22	19°.71	18°.9	19°.73	17°.55	14°.43	18°	Av. da. range 17.65.
WIND.—N. prevailed on.....	12 dys.	9 dys.	11 dys	9 dys.	4 dys.	5 dys.	4 dys.	0days	7 dys.	7 dys.	2 dys.	3 dys.	Total 73.
E. " "	6 "	1 "	7 "	5 "	8 "	6 "	7 "	4 "	4 "	4 "	3 "	2 "	Total 57.
S. " "	3 "	4 "	2 "	9 "	10 "	11 "	5 "	14 "	10 "	6 "	13 "	3 "	Total 90.
W. " "	10 "	14 "	11 "	7 "	9 "	8 "	15 "	13 "	9 "	14 "	12 "	23 "	Total 145.
Prevalent Direction ..	N. W.	N. W.	N. W.	N.	S. E.	S.	W.	S.	N. W.	N. W.	S	W.	Prevalent wind W.
Mean Force.....	2.5	3.1	2.3	2.5	2.4	2.4	2.7	2.2	2.	2.7	2.5	2.9	Average 2.52.
No. of Gales....	2	1	0	1	0	0	1	1	1	1	2	1	Total 11.
No. of Foggy Days..	0	1	0	1	6	4	7	14	1	2	5	1	Total 42.
Lightning on.....	0ds.	0ds	0ds	1 dy	0ds.	1 dy	3ds.	1 dy	0 dy	1 dy	0ds.	0ds.	Total 7.
Thunder on	0 "	0 "	0 "	1 "	0 "	0 "	3 "	0 "	0 "	1 "	0 "	0 "	Total 5.

* Those marked as *Dry* Days are the days on which no rain or snow whatever fell; though on many days not so recorded the precipitation was so minute as to be inappreciable.

ON HYLA SQUIRELLA A BATRACHIAN,—NEW TO THE PROVINCE.

(*See Proceedings, Page* 2.)

In my paper on the Reptilia of Nova Scotia, read before the Institute in May, 1865, the only species of tree frogs then known to be inhabitants of the Province were published as *Hyla versicolor* and *Hylodes Pickeringii.* Through the assiduity of Mr. Arthur Silver, I am now enabled to add another species to the list, viz.: the Squirrel tree Frog, or Little Peeping Hyla (*Hyla squirella*).

It appears that this little frog is very widely distributed over the North American continent. It has been traced as far north as the State of Massachusetts. Storer included it in his report upon the zoology of the State. He, however, appears never to have seen one in a living state, and only made his remarks upon a dried specimen which had been taken at Roxbury. We should therefore consider ourselves fortunate in being able to add to our number a form which would appear to be rare in the northern portion of the United States. It is common in the Southern States; but Dr. Holbrook, who published some years ago an elaborate work upon North American Herpetology, considered the northern form to be a distinct species from that of the south. Dr. Gunther, the compiler of the catalogue of Salient Batrachians in the collection of the British Museum, who is considered our most able herpetologist, places the New York and Georgian animals together. We must therefore conclude that, if any difference exists between them, it is too slight to allow of a separation to be made. The northern squirella, however, is somewhat smaller in size than the southern. Le Conte states that it is generally found under logs and bark of decaying trees, but in the case of our Nova Scotian specimen it differed in habit, being found resting on a leaf. Le Conte, however, most probably procured specimens in autumn, when the tree frogs were taking to winter quarters, and this may account for his finding his specimens under logs and bark of trees,—positions which would never be resorted to by arboreal species possessing fingers and toes terminating in rounded viscous pellets especially suited to a life among foliage.

The tree frogs reside habitually among the foliage of trees, among which they hop and leap almost with the agility of the birds that tenant the groves conjointly with them.—They are able to cling to the leaves on which they alight with exact precision, and to walk on them in all positions, and even on their under surfaces without falling off,—just as a fly alights on the ceiling of a room, and rests or crawls there. Each finger and toe, for so we will name the digits of the fore and hind feet, is dilated at the tip with a circular pallette or pad, varying in size in different genera; these little cushions are, it is true, moistened with a glutinous fluid, as is the whole surface of the body; but this gluten has been proved not to be the only means by which the frog is enabled to cling to perpendicular or other singular positions; but that the pallettes act as suckers, being sustained in their position by the pressure of the atmosphere, a vacuum being produced beneath them, or removed at the will of the animal.

The tree frogs differ not only in size and general appearance from the frogs proper, but also in the formation of their cuticle. The skin of the under surface, instead of being smooth as in our common green frog for instance, is covered with granular glands, pierced by numerous pores, through which the dew or rain spread on the surface of the leaves is rapidly absorbed into the system, and reserved to supply the moisture needful for cutaneous respiration. In connection with this system of respiration some curious facts have been brought to light by experiments with tree frogs kept in confinement. A tree frog, taken from its cage and placed upon a board sprinkled with water, has been seen to apply its body as close as possible to the moist parts, and from this absorption, though in an emaciated state before, has become plump. A frog that had not been allowed to enter water during the night was weighed and then immersed. After it had

remained half an hour in the bowl it came out, and was found to have absorbed nearly half its own weight in water.

The geographical distribution of tree frogs over the globe gives to America the majority of species known to exist, for of 64 species described, no less than 37 are found on our continent,—and, of the remainder, one is found in Southern Europe; five are peculiar to Africa; eight to Asia, and ten to Australia and the Indian Archipelago.

The Hylodidæ, of which our Pickerings Hylodes is a member, are peculiar to the American continent and West Indian islands, and of this family eight species are known to science. I may remark that the Hylodes differs from the Hyla in having the fingers free while the latter has them more or less webbed generally, though not always. The toes in the Hylodes are free, while in the Hyla they are, with the exception of one species, broadly webbed. In the Hylodes also the disks are small, while in the Hyla they are very conspicuous.

J. M. Jones.

CRUDE NOTES ON STORMS, AND HOW TO NOTE THEM.

By J. L. Hurdis, *Cor. Member of the Institute.*

If the equator be considered a region of heat and moisture, and the poles of the earth regions of atmospheric condensation, precipitation, and frost, the 90° which separate these parts of the earth must necessarily be subject to various conditions of temperature, arising not only from change of seasons, but, in particular, from the the direction of the wind; for, as all winds from equatorial regions are warm winds, rarified by heat, and charged with evaporation, so all winds proceeding from either of the poles, will be cold winds, comparatively devoid of heat and moisture. Consequently, a Barometer, placed in any intermediate latitude, will *rise* when the condensed and heavier atmosphere of the polar regions approaches it, and vice versa, *fall*, when in contact with the rarified, moist, and lighter atmosphere from the regions of the equator.

Thus do the extremes of heat and cold govern the atmospheric circulation of the globe—the superabundant heat and moisture of the equator flowing towards the poles, and the dry, condensed atmosphere of the frozen regions overflowing towards the equator.

If we examine the lettering of the Barometer prepared under the instructions of the late Admiral Fitzroy for the use of our sea-going population, and which we may presume to represent his personal experience on this point, so far as the northern hemisphere is concerned, we find all the indications for a *rise* to be northerly, or what may be termed polar,—while on the opposite side the indications of a *fall* are entirely of a southern or tropical character, and accord precisely with the principles I have now endeavored to lay down. The lettering below this, extending to the bottom of the scale, is exceptional, purely cyclonic in character, and therefore not applicable to the ordinary currents of atmosphere which prevail in every quarter of the globe.

We are still imperfectly acquainted with the nature of the cyclone or revolving storm. That these storms are generated by heat, within certain parallels of latitude, extending around the entire globe, appears to be well authenticated. In the northern hemisphere this region may be said to extend from the 10th to the 20th degrees of latitude, and is separated from a similar zone in the southern hemisphere by the great equatorial belt of calms and constant rain.

Cyclones, in the northern hemisphere, revolve round their centre from right to left, while those of the southern hemisphere revolve in the opposite direction.

In the northern hemisphere these storms commence in the month of August, and certainly prevail in the North Atlantic till the middle of March, and there can be little doubt that the same rule holds good in other parts of the same hemisphere.

If a similar rule be applied south of the equator, where seasons are reversed, these storms would then commence in February, and be occasionally experienced to the middle of September.

All revolving storms move in a curvilinear course, at rates of speed varying from twenty miles an hour to ten, or even less. Those of the northern hemisphere first move in a west or north-westerly direction—then northerly, curving at or near latitude 30° to the north-east, and proceeding onward in that direction towards the pole. In the southern hemisphere these storms obey a similar law of nature, first moving towards the west and south-west, then southerly, curving in or near latitude 30° to the south east, and so continuing their course to the frozen regions of the Antarctic.

During the prevalence of a cyclone the barometer will be found an invaluable guide. This wonderfully sensitive instrument will indicate by a fall of the mercurial column the moment a storm is in contact with it, and this fall will continue until the advancing moiety of the storm has passed by, or over, the instrument the—mercury then begins to rise, and continues to do so while the latter portion of the storm-circle is passing, when it will register the original atmospheric pressure, or nearly so, except it may be in the wake of the storm, where the disturbance will be great, and require a longer period to subside.

By carefully observing and noting the direction of the wind at the commencement and termination of a cyclone, two points will be established on the circumference of the storm-circle, and a line drawn through these points will show the position of the observer, from point to point as the storm swept over him. Another line drawn parallel to this chord, through the centre of the circle, will show the onward direction of the storm.

The direct speed and the diameter of a cyclone may be ascertained by noting the exact time which the storm takes in passing from one known locality to another, and its duration at either of these places. Thus, the cyclone which visited Turk's Island and New Providence in October, 1866, was 33 hours in passing from one island to the other, the distance traversed being 405 geographical miles, which is equal to a direct speed of 12 3-11 such miles per hour. If this rate of speed be multiplied by 16 hours, the duration of the cyclone at Turk's Island and at New Providence, we have 196 4-11 geographical miles as the diameter of the storm at that period of its existence. In passing over New Providence, the central calm of this cyclone lasted for one hour and thirty minutes, which, calculated by the same rule, would make the diameter of that centre 18 2-5 miles.

Should any one ask for my definition of an east or a west wind, I would answer, that all winds from these points may be considered lateral deviations of the polar currents, seeking, in obedience to the laws of gravitation, areas of lesser atmospheric pressure, and winding in their courses for thousands of miles, sometimes in one direction, and sometimes in another, like the waters of somo great river on its jonrney to the ocean.—They have certainly no separate, distinct, or specific character; and the barometer heralds their approach like other winds.

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

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T. F. KNIGHT, ESQ.,
J. CAMPBELL.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. II. 1864-5. PART III.

CONTENTS.

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PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME II. PART 3.

Anniversary Meeting, Oct. 12. 1864.

In accordance with the Rules of the Institute, the Anniversary Meeting, of which due notice had been previously given to all the members, was held on Wednesday, Oct. 12, 1864, when the following gentlemen were elected by ballot, to fill the various offices for the ensuing year :—

President.—J. M. Jones, F. L. S.

Vice-Presidents.—Capt. Hardy, R. A., Dr. B. Gilpin, M. D.

Treasurer.—Capt. Lyttleton.

Secretary.—Wm. Gossip.

Assistant Secretary.—A. S. Finnie.

Council.—Dr. DeWolf, Professor Lawson, Dalhousie College, Colonel Myers, W. C. Silver, J. H. Duvar, P. S. Hamilton, Jos. Bell, Lieut. Deane, 17th Regiment.

Mr. C. E. Brown, proposed at a previous meeting, was duly elected a member of the Institute.

It was *Resolved,*—That any gentleman duly elected a member of the Institute, and desirous of becoming a Life Member, may be admitted as such on payment of ————.

[At a meeting of Council, Oct. 24, it was *Resolved,*—That the blank be filled with *Five Pounds.*]

Ordinary Meeting, Nov. 7, 1864.

Capt. King, R. A., proposed at a previous meeting, was duly elected a member of the Institute.

Dr. B. Gilpin read a paper on a species of *Salmo*, found in some of the Lakes of this Province. *(See Transactions.)*

Conversation ensued relative to the habits of the *Salmo* family. It was stated that they assume, in a greater or less degree, the prevailing colour of

the locality they frequent. The difference in colour between the fish of warm climates and those of northern or temperate waters, was noted—the tints of the former being warm and bright—the latter generally sombre and subdued; it was also remarked that the colours of southern fish become modified when, as is sometimes the case, they travel northward. The species described by Dr. GILPIN were stated to weigh about 3 lbs. full grown, but they have been taken weighing 6 lbs. The opinion of the meeting was in favour of the fish being considered a new species. [This opinion has not been sustained on further enquiry and research.]

Dr. GILPIN read a paper—"On some of the Mammals of Nova Scotia"—being a continuation of papers under his name, in the published Transactions of the Institute. The paper described the *Condylura cristata;* also the only two species of Bat known to exist in Nova Scotia—*Vespertilio subulatus*, and *V. pruinosus. (See Transactions.)*

In the conversation on these subjects, some doubts were expressed as to the *Condylura cristata* being the only species of mole in Nova Scotia. It was stated that *V. pruinosus* was found occasionally, but rarely, in Canada,—that one had been taken in Bermuda, brought from other parts in the sail of a ship,—that a similar instance had occured, of one being found in the sail of a ship belonging to Mr. West, lying at his wharf in this city, which had just arrived from the West Indies.

The President read some notes on the Great Auk, *(Alca impennis,)* a very perfect skeleton of which was produced. It had been procured through the kindness of the Bishop of Newfoundland, (the Right Rev. Dr. FIELD,) from the Funk Islands off that coast, and was one of the only two specimens that remained of the bird, which like the Dodo had become extinct. *(See Appendix.)*

Various speculations were hazarded on the causes which may have led to the extinction of the Great Auk, once so numerous on the coast of Newfoundland and adjacent islands—the principal of which was supposed to be the destructive agency of man. Some doubt was also expressed as to the total extinction of the species.

ORDINARY MEETING, DEC. 5, 1864.

A note was received from His Excellency the Lieut. Governor, PATRON of the Institute, regretting his inability to be present, owing to previous engagements.

Professor JOHNSON, of Dalhousie College, proposed at a previous meeting, was duly elected a member of the Institute.

Lieut. WEBBER, R. A., proposed at a previous meeting, was duly elected a member of the Institute.

Dr. B. GILPIN read a communication from the Essex Institute, Mass., calling attention to a proposal to publish a Naturalist's Directory. It was accompanied by a blank form to be filled up with Naturalists' names, and their special departments of study. [The publication has since been received, and is a very useful book of reference.]

Dr. B. GILPIN read the following letter from Dr. DAWSON, Principal of McGill College, Montreal:—

NOTE *on a Species of Gemellaria from Sable Island.*

Among some specimens from the above locality collected by Mr. J. R. WILLIS, and kindly sent to me by that gentleman, is a large tuft of a *Gemellaria*, which I regard as new. In Busk's Catalogue of the Polyzoa in the British Museum, only one species is noticed, *G. loriculata*. Dr. Stimpson* has described a second from the Bay of Fundy, under the name *G. dumosa;* but Mr. WILLIS's specimen differs from both. I have therefore prepared a detailed description of it, and desire to dedicate it to Mr. WILLIS, its discoverer, as a testimony of my appreciation of his services in the investigation of the Marine Zoology of Nova Scotia.

GEMELLARIA WILLISII, S. N.

General Appearance.—Cœnæcium branching in dense tufts from a stout stem (attached to a sea-weed). Height of largest specimen, 2½ inches. Fibres flexible, but somewhat brittle; membranous in texture, but effervescing strongly with an acid and leaving a very delicate membranous skeleton. Colour brownish white or light fawn.

Microscopic Characters.—Pairs of cells seen in profile have at top and bottom a breadth of about one-fifth their length. From the top they increase in width to the base of the aperture, which is a little above the middle of the cells, where the breadth is equal to about one-third of the length, decreasing regularly toward the base. Single cells seen in front are broadest at the top, where the aperture occupies nearly the whole breadth. Aperture oval-ovate, covered with a flat membrane having a semicircular slit at top. In branching, the highest pair of cells give off from their sides a pair of branches, and usually also one or two stems from their upper ends. This gives to the Cœnæcium a densely tufted character.

The species differs from *G. loriculata* of Britain in its narrower and less inflated cells and longer apertures, and in its more dense habit of growth, arising from the mode of branching above indicated. It differs from *G. dumosa* of the Bay of Fundy, in so far as can be ascertained from the short description of that species, in the form of the aperture.

In my collections from Nova Scotia I have only the following additional species of *Polyzoa*, all of them found also in the Gulf of St. Lawrence:—

Membrampora pilosa,	Lepratia pertura,
Lepratia armulosa,	L. variolosa.
L. trispinosa,	

This very short list might no doubt be largely increased by a little attention to the subject, and these curious and beautiful little organisms are well worthy of the notice of collectors, especially of those who take an interest in microscopic objects.

J. W. DAWSON.

Capt. HARDY read a paper on Provincial Acclimatization. *(See Transactions.)*

Professor LAWSON read a paper entitled—"Notice of the Occurrence of Heather *(Calluna vulgaris)* at St. Ann's, Cape Breton Island. *(See Transactions.)*

In the after conversation it was stated by a gentleman present, that *native* heather had been found on the Halifax peninsula,—[which however is not sufficiently substantiated.] It is frequent in gardens as an exotic. Evidence was adduced to prove that it had been known in Newfoundland for a long period, and is generally supposed to be an indigenous plant. An opinion seemed to prevail however, that the instances remarked upon, of its being found in Massachusetts, Cape Breton, or on the Halifax peninsula,

* Marine Invertebrata of Grand Manan.

may have been propagations from plants brought to those countries by emigrants.

Dr. LAWSON also made some observations on Lemania, an aquatic plant found in the United States, and more recently in Canada; and which he had also met with, adhering to stones, in the Sackville River, at the head of Bedford Basin. *(See Transactions.)*

ORDINARY MEETING, JAN. 9, 1865.

The President noticed the receipt of several donations since the last ordinary meeting, viz.:—

1. By Capt. HARDY. Vol. V. of the Natural History of the State of New York.

2. By Miss WILLIS. A Collection of Nova Scotia Ferns.

The President noticed the receipt of Letters, Transactions and Publications, as follows:—

1. A letter from the Smithsonian Institute, informing that the Nova Scotian Institute of Natural Science had been placed upon their List for exchange of publications.

2. From the Essex Institute, Salem, Mass., acknowledging receipt of Vols. I. and II. of Transactions of the Nova Scotian Institute, and sending their Proceedings in return.

3. From the Academy of Science, of St. Louis, Missouri, with Part I. Vol. II. of their Transactions, and notifying that the Nova Scotian Institute had been placed upon their exchange List.

4. From Sir W. Jardine. The Address of the President of the Dumfries and Galloway Natural History Society. Also.—The Transactions and Journal of the Proceedings of the Dumfriesshire and Galloway Natural History and Antiquarian Society.

5. From Dr. Dawson, Principal of McGill College, Montreal. A paper "On the Fossils of the genus Rusophycus."

6. From Thomas Belt, Esq. A paper on Lake Basins, and the evidence of glacial action in their excavation.

Mr. A. DOWNS read a paper on the Land Birds of Nova Scotia, describing sixty-one species, of which sixteen were warblers. He purposes a continuation of the subject. *(See Transactions.)*

Rev. J. AMBROSE, of St. Margaret's Bay, read a paper on the Natural History of St. Margaret's Bay—with especial reference to the Sea Birds that frequent its waters. *(See Transactions.)*

The President read a letter from Professor OWEN, relative to remains found in the Kitchen Midden at St. Margaret's Bay, explored by the Institute on one of their Field Excursions last summer, and described in the Appendix of Vol. II. P. II. of their Transactions. (*See Appendix.*)

Colonel SINCLAIR, proposed at a previous meeting, was duly elected a member of the Institute.

Mr. SANDFORD FLEMING, proposed at a previous meeting, was duly elected a member of the Institute.

ORDINARY MEETING, FEB. 6, 1865.

Mr. DUVAR read a paper entitled—"Contributions to the Game of Nova Scotia." (*See Transactions.*)

In the conversation the necessity was recognized that measures should be taken to preserve the Game of the country, all varieties of which were fast decreasing, owing to the wanton destruction of species on the one hand, and the absence of precautionary measures, especially with reference to the river fisheries, on the other. The introduction of foreign species likely to thrive in this climate, was also strongly advocated—of the feathered tribe especially, which would enliven our forests and farm yards with their presence and melody.

The Secretary read a paper sent by Mr. BELT, "On the Formation of Lake Basins by Ice action." (*See Transactions.*)

It was urged in after conversation on the subject, that the conformation of a country, independent of other causes, would be sufficient to account for the formation and direction of lakes and rivers; but that there was good evidence, especially on the Atlantic coast of Nova Scotia, that glacial action must have powerfully assisted their excavation there. The metamorphosed rocks at the bottom and on the shores of many of them, were worn smooth and covered with striæ, not by the action of the present waters or wintry ice, but by those of perhaps thousands of ages in the past; and the course of these Atlantic streams was generally in the direction of the glacial drift. Bedford Basin, at the head of Halifax Harbour, was instanced as perhaps partially formed by glacial erosion; and as probably a lake ere the icy pressure at the Narrows forced the barrier, and opened a communication with the sea. In connection with the subject, and in the course of explanation of lake phenomena, a centre of dispersion of erratics, commencing at the heights around Major's Lake, a few miles from Dartmouth, and spreading in a southerly direction towards Cole Harbour, was noticed.

ORDINARY MEETING, MARCH 6, 1865.

The President acknowledged a donation to the Institute by Lieutenant WEBBER, R. A., of a Geological Cabinet, containing specimens of minerals and fossils, including those of all formations from the Primary to the Tertiary inclusive.

The President read a paper sent by Professor HOW, of King's College, Windsor—"On some of the Brine Springs of Nova Scotia." (*See Transactions.*

In the discussion that ensued, evidence was adduced of the occurrence of other mineral springs in various parts of the Province, and it was stated that the waters were used by the inhabitants in their neighbourhood for the purpose of curing various complaints. A sulphur spring at Cranberry Cove, Cole Harbour, was mentioned as situated near the site of a Kjoekkenmoedding.

The Secretary read a paper "On the Antiquity of Man." (*See Transactions.*)

After the conclusion of the paper, some interesting remarks were made concerning the aboriginal inhabitants of Nova Scotia, who formed the Kjoekkenmoeddings of the coast, by which it appeared that the race was almost identical in their mode of life with those of the European coasts,—similar material being found in both; only the rude pottery of Europe differed somewhat in the colour of the clay of which it was made, from that found in Nova Scotia.

The President read a letter from Admiral Sir ALEXANDER MILNE, recently Naval Commander-in-Chief on this Station, communicating interesting information, the result of many years experience, on the extension of the Gulf Stream. (*See Appendix.*)

The Secretary reported, that in accordance with a Resolution of the Council of the Institute, he had forwarded to the Honble. the President of the Legislative Council, and to His Honor the Speaker of the House of Assembly, respectively, the invitation of the Institute to the members of both Branches of the Legislature to attend their ordinary meetings during the Legislative Session.

ORDINARY MEETING, APRIL 6, 1865.

Colonel MYERS read a paper entitled—"Notes on the Weather at Halifax, Nova Scotia, during 1864." (*See Transactions.*)

During the discussion which followed the reading of this paper, the President read a letter from Professor HENRY, Secretary of the Smithsonian Institute, stating that the Institution would be glad to receive a daily telegram giving an account of the state of the weather, direction of wind, &c., at Halifax. It was the opinion of the meeting that such a request should be complied with, and the military authorities memorialized to allow such observations to be delivered to the Institute for transmission to the Smithsonian.

Dr. B. GILPIN read a paper—"On the Gaspereau" (*Alosa tyrannus*). (*See Transactions.*)

After the reading of Dr. Gilpin's paper, some of the members made remarks upon the habits of this fish; and its rare custom of rising to a fly was placed beyond doubt by a gentleman present stating that he had caught one while trout fishing, with an artificial fly, last summer, on the Nine Mile River.

The Secretary read the following extract from a letter he had received from E. MARET, Esq., of St. John's, Newfoundland, an Associate Member of the Institute:—

"ST. JOHN'S, March 21.

"I have not been able to do much in the way of investigation, but previous to leaving the west coast an arrow head of *flint* was given me by Mr. LeGallois, which he had just found in the course of one of his journeys. I have also obtained some handsome comb shells, as well as a very fine specimen of cockle.

"We have had a most extraordinary winter, exceedingly mild with occasional severe frosts. At present (March 21) there is scarcely any snow on the ground, an unusual thing for Newfoundland.

"Contrary to my former experience, I find that Frogs do exist in Newfoundland, and several colonies of them inhabit the ponds and lakes about St. John's, though

whether introduced or indigenous, or whether the same as those of Nova Scotia, I cannot say. At all events they are not numerous.

"I also find that snails, similar to the common English snail, exist in certain localities."

ORDINARY MEETING, MAY 1, 1865.

The PRESIDENT read a paper—"On the Reptiles of Nova Scotia"—illustrated by preserved specimens. (*See Transactions.*)

In the conversation that ensued, a doubt having been expressed with reference to the young of snakes passing for safety into the mouth of the mother, which had been stated of the *Coluber sirtalis*, a gentleman present (Mr. Nash) said that he had been a witness of the fact on more than one occasion, in the vicinity of Truro. He could not ascertain whether it was owing to inducement on the part of the parent, or instinct on that of the young. Nor had he ever seen the young snakes return from such a place of concealment or safety. [This statement by a gentleman of unquestionable veracity, may help to resolve the doubts of naturalists on the subject.]

The Secretary read a paper sent by Professor HOW, of King's College, Windsor, entitled—"Notes on the Economic Mineralogy of Nova Scotia." It treats upon the Ores of Manganese and their uses. (*See Transactions.*)

An interesting conversation succeeded the reading of this paper. Mr. Nash, who is interested in the Teny Cape Manganese Mines, in Hants County, assented to the general correctness of the details which had been read, relative to that enterprise. He mentioned the occurrence of Manganese at other places,—at Wellington Mountain, Cape Breton,—also, at Falmouth, Hants County. He had been informed by Dr. Johnson that it occurred on or near to his land in Pictou. Mr. Nash stated that some hundreds of tons had been sold in Liverpool, England; and some also in Boston, where it is used for a particular purpose. The working had so far paid very well. He had in his possession Bog Manganese from Antigonishe, and some had been sent to him from Ship Harbour. He was firmly persuaded that the best Manganese the world could produce, was to be found in Nova Scotia.

The PRESIDENT made some appropriate observations upon the progress of the Institute, and its prospects for the future, and closed the ordinary meetings for the season. He also announced that a Field Meeting of the Institute would take place in each of the Summer and Autumn months until October next, when the Ordinary Meetings would be again resumed.

WILLIAM GOSSIP,
Secretary.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

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

NO. II.

[*Read November* 6, 1864.]

Having in my first number given the members of the Soricinæ family inhabiting this Province, as identified by myself, I now proceed with the Mammalia, at least those that I have identified myself.

Genus, Condylura.

Condylura cristata.—A rather large specimen from alcohol, taken at Annapolis Royal, 1862, during summer, measured—extreme length, 8¼ ins.; length of tail, 3½ ins.; diameter of tail, ¼ in. Colour—dark blue-black above and below, nails flesh colour, the tail covered with scales that are concealed by stiff hairs, compressed at base, swelling out suddenly about two-thirds of an inch from base and then narrowing to a fine pencil at point, at its largest part at least a quarter of an inch in diameter; the nose with twenty-two points or rays; the fore feet very broad, oval shaped, fringed with stiff hair and covered above and below with fine scales or scale-like points, the base of each finger excepting the outside one with a pointed peculiar fringe of two or three points like a cock's comb, the nails each ¼ of an inch long, the hind feet longer and narrower than the fore, and covered above by the same scales, the soles with three or four irregular tubercles; the star-like rays of the nose, and the fringe at the base of the forefingers, seem peculiar to this animal. It is rather common in the Province, and seems to represent the true moles to which it is allied, and which I have never identified here. All specimens that I have had belonged to

one species. I think the tail swells during the sexual period, and when the animal is fat, at other times diminishes.

Genus, Lasiurus.

Having neglected to describe the Bats, in their usual place, before the Soricinæ, I place them here. I have identified but two species myself, but I have little doubt that several more species inhabit the Province.

Lasiurus, cinereus, (Hoary Bat.)—I have seen but two specimens of this bat taken here. One from Sambro, the other taken from the foretopsail of a brigantine in Halifax harbour, and therefore I consider it rare. These specimens answered in every respect *V. pruinosus* of Richardson, DeKay and Say. This latter naturalist, supposing himself the discoverer of it, gave it the specific "*pruinosus*,"—but Dr. Allen in his monograph of North American bats, quotes a catalogue of Peale's Museum, 1796, by M. Palisot de Beauvois, who describes it under the name *cinereus*.

Vespertilio subulatus.—Two specimens measured—total length, 3ins.; total spread, 9ins.; they both agreed with DeKay's description of northern specimens, their colour being darker and ears longer than those of New York. Dark about head; dark brown olive on back; yellow mixed white beneath; yellow down extending a little way under rib of each wing; the ears not so hairy as DeKay's. They are very common.

Genus, Lynx.

Lynx, Canadensis, (Loupcervier.)—A very handsome but not large skin in winter pelage, from Mr. Coleman's, Halifax, measured —length to tip of tail, 3ft. 2in.; length of tail, 3½ins.; of pencil to ears, 1½ins. Colour, dusky brindle on the back, an indistinct but decided dark line down the centre of the back, end of tail deep black, sides and belly yellowish rusty, inside of legs yellowish white, no spots, but three indistinct dusky bars inside fore leg, black tips and pencils to the ears, and a large collar yellowish white alternating with black stripes beneath the throat—a general hoary tint over all. The fur was very long and loose. The legs and feet very robust and well furred, with thick yellowish white fur, and the pads covered. This true boreal species, reminding us of the alpine hare, the ptarmigan, the spruce grouse, and the

snow owl, in his well-furred limbs, is abundant in the Province He loves the thick covers and dense spruce-pine woods of the midland counties of King's and Annapolis, in which he hunts the varying hare, and surprises the dusky grouse, and from which he descends at night to the barns and sheepfolds in the cleared land. He is very destructive to sheep. He rarely is found near the seaboard, or amongst the scanty cover of the granite hills where the red cat abounds, and never like the latter comes out in the open, or into the town in daylight. When pursued, he runs in a high awkward gallop, with an arched back, leaving a very broad trail upon the snow, and soon takes refuge in a tree. About twenty-five years ago the country about Annapolis Royal was infested with them, when Mr. George Hardwicke, a young farmer, with a love for hunting, introduced hunting them with a foxhound. Mounting his horse by day-break of a winter morning, he would ride ten or twelve miles into the forest, dismount, and beat the woods for game. In half an hour the hound would find, and in about twenty minutes more have treed the Lynx in the fork of a spruce-pine tree. Following at his leisure the track on the snow, he easily tumbled her out of the tree by a charge of buckshot, as she hissed and glared at him like an angry cat, with erect fur and arched back. He took twenty during the winter, sometimes two in a day, and a right pleasant sight it was to see him return home, at the close of a short winter's day, with one, if not two, hanging across his croup, as he rode his mare into the settlement, his snowshoes, axe and gun crossing his broad shoulders, all making a pretty woodland scene with the white snow and dark firs beyond. Though cowardly and skulking when opposed to man, one who has witnessed his sudden pounce upon his prey can readily understand his ravages among sheep.

Lynx, rufus, (Wild Cat).—A very large male, shot by Mr. Stayner as he was prowling about the environs of Halifax in 1861, measured—from tip of nose to end of tail, 3ft. 4ins.; to end of hind leg, 4ft. 4in.; from tip to tip of ear, over forehead, 10ins.; tail, 7ins.; the colour above rusty, with a general hoary tint; inside of fore legs, belly, and beneath tail whitish; obscurely spotted with red on flanks and outside paws, and two or three black bars inside fore leg; ear black, with a peculiar half-moon white patch on the

back, and a very small pencil to the tip; some very obscure dusky lines along the top of back, and a few dark lines diverging from the inner corner of each eye to the forehead, and each side of the nose; the soles of fore and hind feet nearly black, the pads naked, and the tail with several obscure dusky annular marks around it, the tip black above, white beneath. A small summer skin from Mr. Thomas, Halifax, now before me, is bright reddish brown on back and sides, a deep brown mark down centre of back, outside of fore and hind legs light reddish; belly, throat and inside of leg whitish, with black bars; the same markings on ears and forehead as in winter skin; scarcely a pencil to tip of ear; the fur short and stiff, except on the belly, where it is fine and loose. This animal is finer and more handsome in its figure and slenderer in its legs than the Loupcervier; its head is finer and bolder, and altogether it has less of the stealthy, awkward gait of the latter. It loves the seaboard and the sterile granite hills. Where it abounds few or no Loupcerviers are seen. Its food is the same, and it is equally destructive to sheep. Its bolder nature brings it down into the open country, and often into the small towns and villages. Perhaps forced by hunger it then prowls about yards, seizing poultry in open day, and is soon shot by a crowd of men and boys.

In studying and comparing our Lynxes, we find that one, the Loupcervier, is a true boreal animal with a limited range. Its short tail, large collar, long pencil to the ear, and furred foot, its large pale yellow eye, (the onyx eye of the ancients,) are all typical of the Lynx of the Old World. On the other hand, the Wild or Red Cat has become indigenous at a far later period. Its naked foot, pencil disappearing in summer from the ear, finer fur, smaller collar, and its ringed and longer tail, all give it a more southern centre of origin, as they also approximate it to the genus "*Felis.*" Baird and Audubon both give it a range from Mexico to the Rocky Mountains, where they are smaller and redder and the pencil disappears on the ear, yet all preserve the peculiar half-moon white patch on the ear, which Baird justly considers typical. It is curious, too, that the less boreal animal is the more abundant—the Wild Cat skin being exported at the rate of five hundred and fifty or more and still abundant, whilst the Loupcervier is becoming scarce and is exported at the rate of about two hundred and fifty.

It is to be hoped they will long be spared as fit denizens of our northern hills and pine forests.

Genus, Canis.

Canis occidentalis, (the Wolf).—I have identified this destructive animal as existing in Nova Scotia. A very large specimen, taken at Windsor, was exhibited in Halifax. I can only mention it to observe how very difficult it appears for some large species to find new habitations. In Nova Scotia the cover and the game are alike and equally abundant as in New Brunswick or Newfoundland, yet twice within this century a voluntary migration of Wolves has been made and both failed. About seventy years ago Wolves made their appearance, but were soon lost sight of. About twenty-years ago they again appeared simultaneously in every part of the Province. The mail courier had scarcely reported one crouching before his off leader in the gorge of the Cobequid hills, before one was trapped at Yarmouth. They seem to have trotted through the whole Province from north to the extreme south, and to have retreated on their tracks with equal stealth; since for twenty years no word has been heard of them. Their instinct taught them that it was no place to found a race in.

Genus, Vulpes.

Vulpes fulvus, (Red Fox).—I have identified but one species of Fox, though subject to varieties, as we will see, by a proneness to nigritism, on studying their skins.

A fine skin, in perfect winter condition before me, has the chin, throat, line down the breast and belly, narrow line along hind legs and tip of tail, white; back of ears, stripe in front of each leg, black; the tail with more or less sooty tips to the hair, inclining to black; a dusky spot on each side of the nose from where the moustachial hairs spring; all the rest of the body a rich lustrous fulvus red, with a slight dash of hoar upon the flanks.

Another skin before me has nose, face, backs of ears, chin, throat, belly, entire legs and tail (except white tip) generally black; shoulders and stripe down the back decided black; forehead, and part of shoulders and flanks, hoary grey, mixed with yellow; the rest of the skin pale yellow. This is the Cross Fox.

In another skin before me, the yellow has entirely disappeared;

belly and under parts, legs and tail (white tip excepted) black; the upper parts black with more or less white hair intermixed in a general hoary tint. This marks the Silver Grey Fox.

In another skin, with the exception of a few grey hairs on either flank, one lustrous jetty black relieved by the snowy tip of the tail, pervades the whole. This is the priceless Black Fox.

The hunter and the fur dealer make seven distinct varieties,—the red, the brander, the cross, the patch, the silver and the black. These are so many stages in the Red Fox becoming black.

In a red skin of the finest colour there are always a few scattering grey hairs upon the flanks, some sooty hairs upon the tail, and a tendency to black upon the belly. Whilst the grey hairs of the flanks are overrunning the whole body, the tail, (tip excepted,) the belly, chin, breast and legs become black. This is the brander,—a red grey fox, black beneath. When the black of the tail invades the back and shoulders, he becomes the cross-fox, or a red grey with a cross on his back. A little red still lingering about the back makes him a patch. When that has entirely disappeared, he becomes silver grey, and when one entire nigritism has pervaded the whole skin, except the snowy tip of the tail, he then becomes the peerless black fox, so seldom seen that he is almost a myth. Though I have seen one at least, which had as few as a dozen white hairs on the flanks. This description is based upon a series of skins, spread out and varying from red to black. Although I do not mean to assert that these changes take place in every one living specimen, yet it seems probable that as the cubs are born dusky, this tendency to nigritism exists, with more or less intensity in each individual at the birth, and prevents the red colour from appearing. At least we must accept this as a reason until we get more certain knowledge. All I mean to advance is that there is a general principle and order in the changes, and that in the reddest skin we find the germ of the blackest. This tendency to nigritism shared by the wolves, and in a less degree by the squirrels, seems to increase in northern latitudes—the proportion of silver and cross foxes in the Hudson Bay Company's list, being about one-third, whilst in Nova Scotia the proportion runs one in ten. I saw two that were taken when cubs at Annapolis. They were kept in confinement for several years, the female greyer than the male, but

they never bred. They seemed slenderer than the red foxes, with longer legs, but I have never seen any specific difference between them and the rest. They are found in the same litter. The white traces on the flank and white tip of tail are common to all, and had they power to found a race it would have been more numerous. The hunters tell you he is a solitary animal, ranging by himself, of a different manner and habit. But carrying twenty pounds on his back he is invested with a romantic interest; he is like a criminal, with blood-money on him; he scarcely shows his brush but there is a general commotion; traps are set on his beat, poison, dogs and men beset his path. The fortunate captor carries his spoils to Halifax, and sometimes secures twenty-five pounds for a skin. Absorbed in the stock of the London dealers, it reappears at the great Leipsic fairs to be contended for by a Russian prince, Hungarian noble, or a Chinese mandarin, where they have reached the incredible price of forty or fifty pounds. The London public were amazed at the large prices attached to these skins at the Great Exhibition. With their proneness to nigritism the red fox abounds in our Province; they keep cover by day, hunting at night. When seen on the open by daylight, he exhibits every mark of caution, stopping, snuffing the air, crouching down, glancing on every side, then advancing, waving his tail from side to side. By-times again he allows an approach without the slightest fear. A young girl coming down the Granville Mountain captured a fox on the road, tied its legs with her garters, put it into her basket and fetched it home. I know another to have been stalked in open day and shot, without the slightest precaution. Doubtless it was this habit in the fox that caused the ancients to say he was affected by epilepsy.

He is a bitter and untiring thief, taking the goose from her nest one night and returning for the eggs the next. He is accused of killing lambs, and justly, as I have known him to have been seen pursuing sheep with full cry and breast erect like a hound. When these imported dainties are not within his reach he contents himself with wild eggs, small birds, hares, mice, and even shell fish and fresh water clams, as the margins of our inland streams quartered up in every direction by his tracks attest. Between two or three thousand skins are annually exported still, though their numbers are sadly diminishing. The red fox skins of Prince Edward Island,

compare favourably with those of Digby County. The beauty and lustre of their skins, either red or black, with their noble brush, relieved by its snowy tip, must be our apology for hoping, notwithstanding he is the prince of vermin thieves, that the day is far off when he will be extinct in our pine-fir covers, or that a mandarin may not expend his fifty guineas to gratify his semi-barbarous tastes.

NOTE.—As this article is passing through the press, Capt. HARDY has given me a bat which from its inter-femoral membrane I think may be V. *evotis*. This will then give us three species.

ART. II. ON PROVINCIAL ACCLIMATIZATION. BY CAPT. HARDY, R. A.

[*Read December* 5, 1864.]

THE very recent and ambiguous term, Acclimatization, implying the subjugation and domestication of wild races of animals; the transplanting of the useful or ornamental amongst nature's gifts in the animal or vegetable kingdoms, between various portions of the globe, for man's benefit; and the hybridization of species,—means but a continuation of the ceaseless efforts of civilized man to utilise and improve all things that were in the beginning created for his use, and placed under his dominion for that express purpose.

Accordingly we find that, in the most important branch of this wide field of experimental research—the domestication of animals,—nearly all the useful beasts, either of burden or for food, and in the various spheres most suitable to their existence in such a subordinate condition, have been thus turned to account from the remotest antiquity. In this branch, mediæval and even modern ages have witnessed no important additions to the classes of animals referred to, although the transplanting and interchange of species has taken place from time to time, and various breeds improved by crossing with foreign varieties. And so for a long time the civilized world rested on the successful, perhaps long-continued efforts of past ages, apparently content with its beasts of burden, its easily reared and fattened cattle, sheep and swine, its domestic poultry of ancient pedigree, and with the indigenous luxuries afforded by the game and

fish of its forests and waters. Variety of food has always been a desideratum on sanitary principles, but sufficient variety appears to have been attained in the well-known animals of the modern farm yard.*

On the other hand, when we turn to the vegetable world, we find that the efforts to domesticate wild species, either for food or ornament, have been continuous and ever-increasing. Forest trees and shrubs, plants with esculent roots, leaves or seeds, those possessing fibres capable of utilisation by manufacture, countless hosts of ornamental and flowering plants, have swelled the lists of modern botanical acclimatizers; and where the all-important condition of suitable climate did not exist, the necessary temperature for the plant's existence was obtained artificially. In accounting for this it will be easily seen how great a difference lies between the cultivation of a new plant and a new animal, thus giving so great a preponderance to the acclimatizers of new species of the vegetable kingdom, when it is remembered that the former demands but two conditions for life and health—the soil and climate of the centre of creation in which it was first placed, or of the natural boundaries to which it has in course of time spontaneously radiated; whilst the new animal does not succeed in any great dissimilarity of these two conditions, and imperatively demands association for the purposes of subsistence, with the same or most similar forms of vegetable life to those of the country where it is found as indigenous. The same argument applies to the transfer of fish to foreign waters, either salt or fresh; and here still greater research is to be inculcated before experimental acclimatization, as their peculiarities of habits and diet are so much less understood.

The recent discovery of the art of artificial hatching of the ova of fish, termed Pisciculture, the increasing frequency and popularity of zoological collections, and the successful experiments made in the

*Well authenticated modern cases of the transmission of large mammals from one country to another occur in the following instances: "The Reindeer was successfully introduced into Iceland about a century ago, while similar attempts failed, about the same time, in Scotland. The Cashmere or Thibet goat was brought to France a generation since, and succeeds well. The same or an allied species, and the Asiatic buffalo, were carried to South Carolina about the year 1850, and the former at least is thought likely to prove of permanent value in the United States. The Yak, or Tartar ox, seems to thrive in France, and success has attended the recent efforts to introduce the S. American Alpaca in Europe."—*Man and Nature; by G. P. Marsh.*

parks of wealthy individuals, in Great Britain and on the Continent, in breeding foreign deer, antelopes, &c., has given rise to extended popular movements in this direction, called Acclimatization Societies, in France, England, Germany, and the Australian colonies. The British Society has offshoots in various parts of the United Kingdom, in New Zealand, and in Palermo. These Societies are supported in some cases by voluntary subscriptions ; others are aided by large legislative grants of money ; whilst all receive great assistance from government in the free transit of animals, &c., by men-of-war ; and in some cases grants of land for experimental parks or farms. The following enunciation of the purposes of the English Society, contained in the Rules, will afford a just conception of the ideas and intentions by which all are animated.

It aims, 1st, at the introduction, acclimatization, and domestication of mammals, birds, fishes, insects and vegetables, whether useful or ornamental.

2. The perfection, propagation, and hybridization, of creatures already domesticated.

3. The spread of indigenous and naturalized animals, &c., from parts of the United Kingdom where they are already known, to other localities where they are not known.

4. The procuring, whether by purchase, gift, or exchange, of animals, &c., from British colonies and foreign countries.

5. The transmission of animals, &c., from England to her colonies and foreign parts, in exchange for others sent from thence to the Society.

6. The holding of periodical meetings, and the publication of Reports and Transactions, for the purpose of spreading knowledge of acclimatization, and of inquiry into the cause of failure.

Without going into minute details of the establishments, their successes and failures, let us here briefly glance at what has been accomplished by these Societies in various portions of the globe during the past three or four years of their infancy. As might be expected, no complete success on so large a scale as to have passed beyond the nursing of the Society, has yet been recorded, whilst failures and disappointments have been numerous and heavy ; yet the Societies are satisfied with their progress, and learning to look more to the necessary qualifications for successful acclimatization, are giving greater attention to a few subjects.

I have before me the Fourth Annual Report of the English Society for the year ending May 31, 1864. A most zealous member and promoter of the Society's objects, Lord Powerscourt, has successfully imported from a German forest a number of magnificent red deer, much larger than those at present found in Great Britain, and hopes by crossing to improve the breed of English red deer, which Mr. Frank Buckland says have been sadly degenerating in size, weight, and general appearance. Recently received specimens of the Wapiti, that magnificent American stag, and of large East Indian deer, are thriving in this nobleman's park.

Repeated failure seems to have attended the experiment of introducing the Chinese sheep, (the same as may be seen at Mr. Downs' establishment at the N. W. Arm). These animals have been disseminated through the country in charge of members, who have nearly all reported unfavorably of the pure breed, though where crossing has been tried there seems to have been more hopes of success. Amongst the birds mentioned as having been bred in the Society's care, are the Honduras turkies, bronze-wing pigeons from Queensland, and a variety of crosses between birds of the genus *Phasianidæ* have been obtained. Many other valuable birds from India, South America, and Australia, have been lately received, but have not yet bred. Amongst the latter are a pair of Australian emeus.

The most interesting portion of the Report, however, comes from the Piscicultural branch, under the guidance of the indefatigable Mr. Francis Francis. It appears that the cost of the apparatus and working it for one year has been only £300, and the Society has sent out amongst its members over 50,000 ova and fry. Many of these ova have been transmitted to the distant colonies of Australia and New Zealand, where the trout and salmon of the Old Country are now living, watched by anxious eyes, the hopeful pioneers of the new races which are to colonise the mountain streams of Tasmania and New Zealand. Of all the Societies in operation, those established by our energetic colonists of the southern hemisphere seem to have been actuated by the greatest zeal, and to have achieved the greatest amount of positive success. That of Melbourne appears to be the parent and first importer of the host of new creatures which are being diffused through the neighboring colonies, on the continent across the water to Tasmania, and even

to New Zealand. The last Report of this Society is so interesting, that it is scarcely possible, in noticing the achievements therein recorded, to refrain from giving the whole *in extenso*. Certainly, in no country on the face of the globe could acclimatization be more applicable, and hence the earnestness of its colonists in this matter. Australia possesses no indigenous ruminant, and scarcely a game bird beyond a variety of aquatic fowl; and the immense success of the introduction of sheep on its vast pasture lands, where no animal had browsed before from the creation, thereby giving the colony its staple product, wool, is in itself an earnest of the great advantages of acclimatization. After noticing the introduction and successful reproduction of the camel, a herd of which were brought from India at the expense of £120 per head, the llamas and alpacas from South America, Cashmere goats presented by the Paris Society, and various breeds of sheep, the Report goes on to say :—

"While devoting this amount of attention to such animals as the camel, the alpaca, the angora goat, and the sheep, which may be considered as more immediately interesting to the mercantile and pastoral classes, the sportsman has not been forgotten. The fallow deer, the Indian elk, the beautiful spotted axis deer, have been successfully imported, bred from, and turned loose at Wilson's Promontory, the Wummera, the Sugarloaf, and the Bunjip. Numerous specimens of the hog-deer of India, a beautiful deer from Manilla, and another from Formosa, are still in the possession of the Society, with a view to their multiplication and ultimate release; and fresh importations of the deer tribe are almost of weekly occurrence.

"The hare has been sent to the Society by the Zoological Society of London, and has been turned out, and is now breeding freely on Philip Island. Various breeds of pheasants, partridges, grouse, and quail, have been introduced, and some have been liberated. Amongst those may be mentioned the Californian quail, which has bred after being liberated in the Botanical Gardens and Philip Island, and the Algerine sand-grouse, of which a considerable number have been imported, and which, from their hardy nature and the similarity of their original climate, may be considered highly adapted to this country. The English wild duck has been imported, has multiplied very freely, and now visits the lagoon at the botanical gardens in nearly equal numbers to the indigenous water fowl. The Egyptian goose has bred at the Royal Park, and promises to be thoroughly acclimatized. The wild pea fowl of Ceylon has thriven and bred in the charge of the Society, and can soon be set at liberty.—The white swan has been introduced in considerable numbers, has bred in the gardens of the Society, and is now distributed in various localities. Various kinds of foreign doves and pigeons have been introduced and liberated. The curassow has been obtained, and has bred in the aviaries of the botanical gardens."

Then comes an enumeration of the various European pond and

river fish, successfully brought over the great intervening wastes of ocean by unremitting care, and including that great desideratum of these enterprising naturalists, the noble salmon, which, however, is expected to thrive and multiply to a far more remunerative extent in the bright cool streams of Tasmania, than in the sluggish rivers of the Australian continent; and lastly, a cheerful notice of the hosts of the common field birds of Old England, now spreading rapidly through the colony by natural means, enlivening the neighborhood of the towns, and doing infinite good to the agriculturists, by attacking the hosts of caterpillars and other insect pests which there prove so destructive to the crops.

As may be supposed, such extended operations could scarcely have been performed without greater assistance than that afforded by even a large assemblage of private subscribers. Indeed, though these have liberally contributed, the Melbourne government, recognizing the vast importance of these efforts to the future prospects of the country, have voted munificent sums to their furtherance. It is stated, that up to the date of the Report no less than £20,000 has been advanced by the government. Foreign Societies of a similar nature, seeing the zeal of the colonists and the aptitude and necessities of the country, have forwarded many new creatures;—indeed, the Report states, that a French man-of-war was at that time engaged in bringing the Society specimens of the yak, the ostrich, and other animals.

There are besides, Societies on the model of that of Victoria, in Sydney, Hobart Town, Adelaide, Brisbane, Auckland, Lyttleton, and Dunedin. So that it may be presumed that in a quarter of a century the strange and sparse fauna of these vast antipodal possessions, will be supplanted by all those beautiful forms of animal life which are so essential to the prosperity and happiness of man in his highest state of civilization, affording variety in food, gratification to the eye, and excitement and health in the chase.

Such then are some of the most important statistics of Acclimatization. That our mother country regards its advantages as far from uncertain or insignificant, may be seen in the fact of her having placed Her Majesty's ships at the disposal of the colonies for transport of specimens. Doubtless the introduction of a new creature in such numbers as to become eventually a common deni-

zen of the country, either wild or in a state of domestication, requires great forethought as regards the aptitude to dwell and thrive in a new home, by comparing the conditions of its past existence with those under which it is expected to live in future. Indeed, without such proper knowledge of the minuter habits and requirements of animals, failure is inevitable ; but more than enough has been shown to establish it beyond cavil as a branch of science, a practical offshoot of the interesting science of natural history.*

We now come to consider the proper subject of this paper—the question of Provincial Acclimatization as applicable to Nova Scotia. I have so far drawn attention to the advances made by the antipodal colonists in this direction, to show how the objections of distance, expense and uncertainty of results, have all been put aside for ends thought worthy of such sacrifices. But Australia was a country craving animal immigration, her large and wealthy population demanding many of the absent table luxuries of the old world, and her youth eager for the time when the boundless forests and grassy plains should abound with the stag or roe, in place of the monotonous marsupials which as yet had afforded the only material for the chase. In Atlantic America, on the contrary, instead of having to supplant the indigenous animals, we possess, in a state of nature, some of the noblest forms of animal life, which no longer called upon to supply the aboriginal Indians with their sole means of subsistence, may be called on with that moderation which should always characterize a civilized people, to afford both the invigorating pleasures of sport and luxuries for the markets. Every stream and lake abounds with trout, and there are but few rivers from Cape Sable to the Labrador which the salmon does not annually attempt to ascend.

What then is to be desired ? Has not America, receiving from the east all those useful animals which accompany man in his migrations, and which, returning to a state of nature in the plains of Mexico and South America, have multiplied so greatly as to afford a staple product for exportation, given all imaginable luxuries to the new-coming nations in the produce of her forests, prairies, rivers, and sea coasts ? Yes, but the gift has been abused. It is sad to contemplate the wanton destruction of game and game fish

* Applied Natural History it has sometimes been termed.

throughout the northern continent since its first settlement by Europeans: many animals, now on the verge of extinction, driven off their still large domains, not primarily by the approach of civilization, but by ruthless, wholesale and wanton modes of destruction. "One invariable peculiarity of the American people," says the author of *The Game Fish of the North*, "is that they attack, overturn, and annihilate, and then laboriously reconstruct. Our first farmers chopped down the forests and shade trees, took crop after crop of the same kind from the land, exhausted the soil, and made bare the country; they hunted and fished, destroying first the wild animals, then the birds, and finally the fish, till in many places these ceased utterly from the face of the earth; and then, when they had finished their work, that race of gentlemen moved west to renew the same course of destruction. After them came the restorers; they manured the land, left it fallow, put in practice the rotation of crops, planted shade and fruit trees, discovered that birds were useful in destroying insects and worms, passed laws to protect them where they were not utterly extinct, as with the pinnated grouse of Pennsylvania and Long Island, and will I predict, ere long re-stock the streams, rivers and ponds, with the best of the fish that once inhabited them."

A home question for our subject would be,—In the hands of which class of men does this Colony now find itself? And I fear the unhesitating answer of the impartial stranger and visitor would be, that in all regarding the preservation of our living natural resources, we were in the hands of the destroyers. The course of destruction so ably depicted by the author quoted, is being prosecuted throughout the length and breadth of Nova Scotia, and the settlers of this Province blind to their own interests, careless of their children, and utterly regardless of restraint imposed by the laws of the country, worse than useless because not carried out, are bringing about the final depopulation of our large wild lands and waters. It really becomes a question as to whether late interference shall arrest the tide of destruction ere the entire extermination of fish and game shall bring the country to a sense of its loss, and finally to a wish for their reproduction.

In such a state of affairs, Provincial Acclimatization would prove an empty speculation, for any new animal or bird introduced into

our woodlands requiring freedom from molestation for a term of years, would be quickly hunted down and destroyed.

Leaving, however, these important questions of protection or extinction of already-existing indigenous species in the hands of those who hold the means of ordering these matters, I will now call your attention to what might be done to increase our stock of useful wild or domestic animals, birds or fish, could they be insured the necessary wardship. We will consider first whether our large woodland districts demand and would bear foreign colonization, and for what types their physical conformation seems best adapted.

Even in its most undisturbed and wildest depths the North American forest has always been noted for its solitude ; the meaning being the great disproportion of the animal to the vegetable kingdom. It seems as if nature had exhausted her energies in shading the ground with the dense forest and the rank vegetation which every where seizes on the rough surface beneath. It is impossible to say to what extent animal life might have once existed in the primeval forest; but no one who has taken a day's walk in the woods, either near to or far from the haunts of man, can fail being impressed with the apparent absence of animal life. The European visitor, in a suburban ramble through the bush, wonders at the scarcity of game birds, rabbits, or hares, but is astonished when told that in the deepest recesses of the wild country he will see but little increase of their numbers. A canoe paddled through lake after lake of our great highways of water communication, will see but a few pairs or broods of exceedingly timid waterfowl, where in Europe they would literally swarm. Surely then, here is room for the work of Acclimatization, in a country where so much toil is undergone in the often fruitless pursuit of sport.

The undergrowth of our wild forest lands, the field for Acclimatization which we have under immediate consideration, consists of an immense variety of shrubs, under-shrubs, and herbs, annual or perennial. The under-shrubs generally bear the various descriptions of berries, and with great profusion. There are here and there wild pastures, or intervales, by the edge of sluggish water, but they bear but a small proportion to the woodlands ; the bogs and barrens produce moss in abundance, and of the kind found in every part of the world where the reindeer is indigenous, or has been successfully introduced, as in Iceland.

We find accordingly, that our largest ruminant, the moose-deer, is in the strictest sense of the word a wood-eater; whilst our other animal representing this class, the American reindeer, or carriboo, is found in those portions of the Province where large and seldom disturbed plains and bogs afford him his favorite moss, the lichen (*range ferinus*). As amongst the larger animals, ruminants alone offer a selection for introduction into a forest country with the physical attributes of Nova Scotia, we may ask if there is any other animal of the deer tribe which might be successfully acclimatized here. The answer comes through careful consideration of the fauna and flora of other regions compared with our own. The field naturally presenting itself for this research lies in the forest districts of America further west, and in northern Europe, which, under similar climatic influences, presents a strong analogy to this portion of the globe, especially on its western seaboard; the forest trees and shrubs, the larger animals, the birds and the fish of Norway and Sweden, are almost reproduced in British North America; indeed, distinction of species in many cases is far from established.

*The red deer then, of Maine and the Canadas, and more recently of New Brunswick, by spontaneous acclimatization, or perhaps rather through the instrumentality of the wolf, appears to be perfectly adapted for an existence in the Nova Scotian woods—a graceful species, but little inferior to the red deer of Europe, affording the excellent venison with which the New York and Boston markets are so well supplied. The climate of Nova Scotia, allowing so little snow to accumulate in the woods until the close of the winter, would prove a great safeguard against the wholesale destruction with which it meets in Maine and New Brunswick, where it is continually in a most helpless condition from the depth of snow throughout the winter. Indeed, it is already with us, for a small herd of healthy animals may now be seen at Mr. Downs' gardens, to whom the country is already indebted for many an unassisted attempt at real practical acclimatization.

The only other ruminant on the list of this order indigenous to climates similar to our own, is the hardy little roe-deer or roe-buck, common in the beech woods of northern Europe. I am confident

* Cervus Virginianus.

that this animal would thrive in the hard woods of Cumberland; and as it seems to live and thrive close to civilization, it would find ample room and food in our suburban copses and uncleared barrens. Descending in the scale of animal classification, the next selections for consideration of a future Acclimatization Society in this country, as adapted to live and multiply and become profitable in the woodlands, seem to be offered in the prolific order *Rodentia*, of which many families are already indigenous—the squirrel, beaver, porcupine and American hare, commonly known as the rabbit. The first of these might receive an interesting accession by the introduction of the black and grey squirrels of Canada and the States; the beaver, porcupine and woodchuck, are all prized by the hunter as food, lacking the supply of venison, and the latter, persecuted though it be by human, furred, and feathered foes, is still so prolific and common, as to form a great portion of the winter subsistence of both settlers and the poor of this city. Indeed, when we enumerate its enemies of the animal creation, which almost altogether live upon it, the lynx and wild cat, the foxes, the horned owl, the marten and the weasel, and take into consideration the numbers which are taken by man, by snaring them in their easily discovered paths to and from their feeding grounds in the swamps, it is wonderful that they still remain so plentiful. A great objection to the flesh of the American hare, however, is its insipidity and toughness, except when taken young. Far more delicate and esteemed is that of the Spanish, or domestic, and common wild English rabbit, (*Lepus cuniculus*), whilst it would seem that both are of a sufficiently hardy constitution to stand the rigours of our winter. The former is already an acclimatized inhabitant of the sand banks of Sable Island, according to Dr. GILPIN, having been introduced by the honble. Michael Wallace, and increased amazingly, affording the Islanders many a fresh dinner when salt junk is plenty and fresh beef scarce. No easier experiment could be made in applied Natural History, than the extensive breeding of the common grey rabbit by some resident near town, whose premises bordered on uncleared bush or scrub. To commence, a large bank of loosely piled earth and stone might be made, here and there perforated by a length or so of suitable tubing, such as used for drains, the bank enclosed by wire netting, and a few

pairs of rabbits turned in. They would soon tunnel the bank in all directions, and as the families increased they might be allowed to escape into the neighbourhood. A fair warren once established would be the means of a quick colonization of the surrounding country. And the true rabbit living so constantly under ground, would enjoy much greater security from animals and birds of prey than his indigenous congeners.

Still keeping in view the acclimatization of creatures intended to exist in a state of nature and not for domestication, a division of the subject which appears to be most feasible and best adapted to the condition of this Province, let us next turn to the birds.

We have already existing in our woods as game birds, two species of *Tetraonidæ*, or the partridge tribe; the *T. umbellus*, or the ruffed grouse; and the *T. Canadensis*, or spruce partridge—as permanent residents; and as summer visitors the two N. American *Scolopacidæ*, the woodcock and snipe. There is but one representative of the *Phasianidæ*, or pheasant tribe, in North America, the only gift of the new to the old world, whence the domestic race has sprung, and that is the wild turkey. It certainly would appear that our large woodland solitudes offer especial facilities for the introduction of some new members of the grouse family, birds especially formed for existence in cold climates. Formerly common in the Scotch pine forests, now only to be met with in the north of Europe, in Norway, Sweden, and Russia, the magnificent capercaillie or cock of the wood, (*T. urogallus*,) equalling, in the case of the male bird, the turkey in size, presents so tempting an experiment that it should be almost introduced regardless of expense. It appears to feed exclusively on pine shoots. Mr. Bernard, author of a recent work called "Sport in Norway," says it is still common in all large forest districts in that country. I believe this bird loves solitude, and surely he would find it, if essential to his existence, in some of the great expanses of coniferous forest which still prevail in most portions of Nova Scotia. Next in size and beauty might be selected the black game (*T. Tetrix*) of the wilder portions of the British Isles, and numerous in Norway, where it is stated they not unfrequently cross with the capercaillie. This bird is known to subsist on the buds and seeds of the alder, on the berries of the whortleberry, and on the bog cranberry, all of which are so abun-

dant in our woods, and of almost identical species. A successful introduction of this bold, handsome grouse, would add great interest to the wild sports on the open barrens. The hazel hen of northern Europe, (*T. bonasia*), reported to be the best fleshed bird of the grouse tribe, is another association of a country in which spruce woods abound. It is exceedingly like our birch partridge in appearance—a little smaller and wanting the ruff; like the latter, also, its flesh is white. There are many other northern grouse in both the old and new worlds, but none that I should import as so likely to succeed, and as such valuable acquisitions, as the capercaillie and the black cock.

With the fact of the introduction and breeding of the English and gold and silver pheasants at Mr. Downs' establishment we are all acquainted; and the most interesting fact is the well-ascertained capability of the English pheasant to live and find its own subsistence in our woods through a rigorous winter. Why should not this experiment be continued?

It is to be feared that those troops of little songsters with which the fields of England abound, and which have been carefully acclimatized in Australia for old association sake, would die on the first near approach of the mercury to zero. Those that are imported are closely kept within doors. Mr. Downs has two pairs of the European jackdaw, which he hopes will increase in his neighbourhood. These interesting and garrulous little members of the family *Corvidæ*, whose young every English boy covets to obtain and educate to the acquisition of rudimentary speech, would find but few ivy-mantled towers or venerable steeples in which to build their nests; but when Gilbert White informs that for want of church steeples they will build under ground in rabbit burrows, the new-comers would not be long in devising a remedy for the defect.

As a second consideration in connection with this wide subject, let us enquire whether any good purpose could be answered by an attempt at domestication or semi-domestication of our indigenous ruminants, the moose and the carriboo. When we consider that these two species are found throughout the old world, under the same conditions of climate and vegetation which attend them in the new, it appears unaccountable that we have no historic records of the subjugation of the carriboo for domestic purposes by the prim-

itive Indians of the northern coasts of America, as this animal has been applied from time immemorial by the Lapps.

An eminent naturalist, Dr. Gray, in delivering his address in the Nat. Hist. Section at the late meeting of the British Association at Bath, thus alludes to the latter fact : "The inhabitants of the arctic or sub-arctic regions of Europe and Asia have partially domesticated the reindeer; and either Asiatics have peculiar aptitude for domesticating animals, or the ruminants of that part of the world are peculiarly adapted for domestication;" and he then instances a variety of exemplifications, in their having domesticated the yak in the mountain regions of Thibet and Siberia, the camel and dromedary in central Asia, in southern Asia the zebra, and in the Malayan archipelago various species of buffalo and wild cattle. It may be stated, that modern geological discovery has placed the original home of the reindeer in the high Alps of central Asia, whence these animals, followed by their ever-accompanying human associates, the Lapps, migrated to the northwest of Europe. As a beast of burden, however, to traverse those treeless wastes answering to the snow-covered barrens of Lapland, the dog seems to have answered all the purposes of the Esquimaux and other arctic-American tribes, whilst in more southerly and wooded regions, a sledge-drawing animal would have no scope or sphere of employment. And viewing the animals in this light, the horse and the ox which have accompanied Europeans, have left no desideratum that could be supplied by either the moose or the carriboo. There are, however, several undoubted instances of the applicability of the moose to draught. A few years since a settler on the Guysboro' road, named Carr, possessed a two-year old bull moose, which was perfectly tractable in harness. For a wager, he has been known to overtake and quickly distance the fastest trotting horse on the road, drawing his master in a sleigh, the guiding reins being fastened to a muzzle bound round the animal's nose. Another instance was that of a very large moose kept by a doctor in Cape Breton, which he would invariably employ in preference to his horse when wishing to make a distant visit to a patient, and in the shortest time. It is very certain that in its youth the moose is one of the most tractable of animals; but it is in the rutting season

of the third year that the males become unmanageable and dangerous.*

The point, however, on which I wish to engage attention, is not the domestication of either of these animals in the state in which the ordinary domesticated animals are associated with us, but a possible state of semi-domestication, by which the moose might be caused to multiply on uncleared land, and regularly bred, fattened, and turned to profit without the smallest cost to the owner, except the expense of maintaining his enclosures in an efficient state of security. My attention was first drawn to this by reading an account of the successful breeding of the American elk (*C. Wapiti*) by an American gentleman, a Mr. Stratton, of New York State. I quote from a letter dated January 12, 1859:

"My desire to keep and breed them, without their becoming a tax upon me, led to diligent enquiry in relation to what had been done in the way of their domestication. I procured, as far as possible, every paper, book, and document, which could give any light upon the subject. I wrote to every part of the country whence any information could be obtained, and opened a correspondence with those who had undertaken such an enterprise. The result of my efforts was simply this: nearly every one who had owned an elk was a gentleman amateur, and had left the care and direction to servants;—that the bucks, not having been castrated at the proper age, had become unmanageable:—and when the novelty of the attempt was over, the domestication in most cases was abandoned. But from my own inquiries, and a close personal observation of the habits of the animal, I believed that a different course would produce a more favorable result. The first requisite was a place to keep them in. Now, they had always lived in the woods, summer and winter: why not live in the forest again? Acting on this principle, I immediately set to work and fenced in about 150 acres of hill land, which was steep and stony, covered with brushwood and entirely useless for agricultural purposes. In this lot I turned my elks, where they have been six years. In the mean time I purchased two more does, and have reared eight fawns. Having emasculated the older bucks as fast as the younger ones became adults, I have now a herd so gentle, that a visitor at my farm would hardly imagine that their ancestors, only three generations back, were wild animals. And this has been done simply by visiting the park two or three times a week, and always carrying them an ear of corn, some little delicacy, or salt, and treating them with unvarying kindness.

"The facility for extending this business may easily be conceived. New York alone might support 100,000 elks on land where our domestic cattle could not subsist, furnishing an amount of venison almost

* Formerly the elk of Europe was used in Sweden to draw sledges, but his use for this purpose was finally prohibited by government, as criminals used it as a means of escape.

incredible; while the adjoining State of Pennsylvania, to say nothing of others, might sustain a still larger number without encroaching upon an acre of land now used for stock-rearing, or any other purpose connected with agriculture."*

Here, then, we have a modern precedent for an experiment which I am convinced would answer in the case of the moose, a still larger and more profitable animal than the wapiti. What an admirable opportunity for utilizing those barren wastes which surround us! Take for example that large triangular piece of waste country commencing at Dartmouth, extending along the shores of the Basin on one side, bounded by the Dartmouth lakes on the other, and skirted by the railroad from Bedford to Grand Lake as its base. With the exception of a few clearings on the shores of the Basin, the whole of this is a wilderness, containing some 13,000 acres of wild, undulating land, with here and there thick spruce swamps, mossy bogs, and barrens covered with a young growth of birch, poplar, and all the food on which the moose delights to subsist. That they have an especial liking for this small district may be gathered from the fact that I have never known it as not containing two or three of these animals. There is no reason why an experimental farm, conducted on the principle followed by Mr. Stratton, should not be able to breed and turn out into this district a very large number of moose, and in such a state of tameness that they would be induced to remain within enclosed portions of the wilderness, furnishing, in proper season, a profitable supply of flesh for the market.

To the carriboo, on the other hand, these suggestions will not be applicable, as this animal requires, as a primary condition of its existence, a large and uninterrupted field for periodical migration.

Art. III. Notice of the occurrence of Heather (*Calluna vulgaris*) at St. Ann's Bay, Cape Breton Island. By Geo. Lawson, Ph. D., L. L. D., *Professor of Chemistry, Dalhousie College.*

[*Read December* 5, 1864]

It gives me much pleasure to bring under the notice of members of the Institute, information and specimens which will, I trust,

*In 1862, Mr. Stratton states that he had succeeded in raising thirty-seven elk. He had trained a pair to harness, and had sold them for $1,000. Whilst, as an article of food he can now raise elk cheaper than sheep.

be sufficient to show that *Calluna vulgaris*, the common heather of Scotland, is a genuine native of our Province of Nova Scotia. When in Cape Breton Island in August last, I obtained information from L. Robertson, Esq., of North Sydney, which led me to make special enquiry at St. Ann's, in the County of Victoria. On reaching that place I found that the *Calluna* was growing in a bit of boggy land among stumps of spruce trees, on an uncleared part of Ulston Farm, belonging to John Robertson, Esq., President of the St. Ann's Agricultural Society, who proceeded with me to the spot, and informed me that he had known the plant to have existed there for about ten years. It was originally noticed by a highlander when mowing, who immediately ran to his master, exclaiming: "I have found heather!" Full enquiry was made on the spot as to the whole circumstances, and I could not ascertain any fact tending in the slightest degree to indicate that the *Calluna* had been planted at St. Ann's. On the contrary, I believe it to be a genuine native. There was only a small patch of it, not more than a yard across, and it had been pretty well eaten down by cattle. Mr. Robertson kindly promised to have a fence put round it to preserve it from farther injury. The "surroundings" of the heather at St. Ann's are most appropriate. Both the scenery and vegetation resemble those of the Scottish Highlands. The cloudberry *(Rubus chamæmorus)*, sundew, and many other highland plants, were abundant on the neighbouring hills. The *Calluna* station is probably not more than one hundred feet above the sea level.

Within the last few years an animated controversy has been going on among both European and American botanists as to whether the *Calluna* is really indigenous to the American Continent or to adjacent Islands. This is in reality a matter of great interest in a strictly scientific point of view, for it has important bearings on the questions of distribution, age and origin of species, and therefore, a reference to the opinions expressed and facts adduced by others, may not be unacceptable as an appendix to my own observations.

The *Calluna* is very general throughout Europe, spreading over extensive tracts of land in Britain, to which it gives the name of "heaths," and over the Continent generally, (not by any means

confined to the North,)* and eastward to the Ural Mountains. That is its eastern limit, for it is not known in Siberia, has been only erroneously reported from the interior of Northern Asia, and is not found in North West America. Humboldt,† after detailing the distribution of heaths and the relations of the North and South African species to those of Europe, remarks, in reference to *Calluna vulgaris:*

"The accurate knowledge which we now possess of the mean temperature of several parts of Northern Asia, as well as of the distribution of the annual temperature into the different seasons of the year, affords no sort of explanation of the cessation of heather to the east of the Ural Mountains. Joseph Hooker, in a note to his Flora Antarctica, has treated and contrasted with great sagacity and clearness two very different phenomena which the distribution of plants presents to us: on the one hand, 'uniformity of surface accompanied by a similarity of vegetation;' and on the other hand, 'instances of a sudden change in the vegetation unaccompanied by any diversity of geological or other features.' * * * * No less striking is the absence of *Calluna vulgaris*, and of all the species of *Erica* throughout all parts of the Continent of America, while the *Calluna* is found in the Azores and in Iceland. It has not hitherto been seen in Greenland, but was discovered a few years ago in Newfoundland."

According to Professor Asa Gray, the earliest published announcement of *Calluna vulgaris* as an American plant, is that by Sir William Hooker, in the Index to his Flora Boreali-Americana (vol. ii. p. 280), issued in 1840, where it is stated that: "This should have been inserted at page 39, as an inhabitant of Newfoundland, on the authority of De la Pylaie." Accordingly, in the seventh volume of De Candolle's Prodromus, to the European habitat is added, "Etiam in Islandia et in Terra Nova Americæ Borealis." But Dr. Joseph Hooker, in his valuable paper on the Distribution of Arctic Plants,‡ observes, "*Calluna vulgaris*, L. is mentioned in De Candolle's 'Prodromus,' on the authority of a specimen gathered by La Pylaie, as a native of Newfoundland; but I find no confirmation of this habitat, nor is it found in any part of the American Continent."

Mr. Bentham had never seen an American specimen, and, remarks Prof. Gray, "he also overlooked the fact (to which Dr. Seemann has recently called attention) that Gisecke, in Brewster's

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* I have specimens from Italy.

† Aspects of Nature. Sabine's Translation. Vol. ii. pp. 144–147.

‡ Linn. Trans. vol. 23.

Encyclopædia, records it as a native of Greenland. No mention of it is made by Dr. Lang, in his enumeration of the known plants of Greenland, appended to Rink's Geographical and Statistical account of Greenland, published in 1857,—from which we may infer that the plant is perhaps as rare and local in Greenland as in Newfoundland, or even in Massachusetts!" In the American *Journal of Science* for September, 1861, Professor Gray announced the unexpected discovery, by Mr. Jackson Dawson, of a patch of heath in Tewksbury, Massachusetts; adding the remark, that: "It may have been introduced, unlikely as it seems; or we may have to rank this heath with *Scolopendrium officinarum*, *Subularia aquatica*, and *Marsilea quadrifolia*, as species of the Old World so sparingly represented in the New, that they are known only at single stations,—perhaps late-lingerers rather than new-comers." Mr. Rand, after exploring the locality, gave a detailed account of the case, and of the probabilities that the plant might be truly native, Professor Gray adding a note to say that the probability very much depended upon the confirmation of the Newfoundland habitat. As to that, Dr. Gray had been verbally informed, in January 1839, by the late David Don, that he possessed specimens of *Calluna* collected in Newfoundland by an explorer of that Island. The Tewksbury habitat was fully described to me and interesting details afforded by Professor Hitchcock, junr., with whom I was a fellow-passenger through Massachusetts in November of last year. Mr. C. J. Sprague took up the subject, and after searching in vain for any publication of Pylaie's containing mention of this heath in Newfoundland, and finding that no specimen was extant in Pylaie's herbarium, or elsewhere that he could trace, he took a sceptical view, and in the Proceedings of the Boston Natural History Society for February and for May, 1862, he argued plausibly from negative evidence, against the idea that any native heath had ever been found in Newfoundland or on the American Continent. However, in the *Natural History Review* for April, 1864, Mr. Hewett C. Watson supplied the following additional evidence of the existence of *Calluna* in Newfoundland:—

"Specimens of *Calluna vulgaris* from Newfoundland have very recently come into my hands under circumstances which seem to warrant its reception henceforth as a true native of that Island. At the late sale of the Linnæan

Society's Collections in London, in November, 1863, I bought a parcel of specimens, which was endorsed outside, 'A collection of dried plants from Newfoundland, collected by — McCormack, Esq., and presented to Mr. David Don.' The specimens were old, and greatly damaged by insects. Apparently, they had been left in the rough, as originally received from the collector; being in mingled layers between a scanty supply of paper, and almost all of them unlabelled. Among these specimens were two flowerless branches of the true *Calluna vulgaris*, about six inches long, quite identical with the common heath of our British moors. Fortunately, a label did accompany these two specimens, which runs thus: 'Head of St. Mary's Bay—Trepassey Bay, also very abundant. S. E. of Newfoundland considerable tracts of it.' The name *Erica vulgaris* has been added on the label in a different handwriting. All the other species in the parcel (or nearly all) have been recorded from Newfoundland, so that there appeared no cause for doubt respecting the *Calluna* itself. And, moreover, the collector had seemingly some idea that an especial interest would attach to the *Calluna*, since in this instance he gave its special locality, and also added two other localities on the label. But there is very likely some mistake in the name of the donor to Mr. Don. It is believed by Sir William Hooker that he was the same Mr. W. E. Cormack, whose name is frequently cited for Newfoundland plants in the *Flora Boreali-Americana*. This gentleman was a merchant in Newfoundland, to which he made several voyages. We should recollect that the *Calluna* advances to the extreme western limits (or out-liers) of Europe, in Iceland, Ireland, and the Azores. The step thence to Newfoundland and Massachusetts, though wide, is not an incredible one."

I hope that some gentleman in Newfoundland will be induced to take the trouble of instituting the necessary inquiries to elicit some more definite information as to the Newfoundland habitat. So many other shrubs have been mistaken for heather in Nova Scotia and other parts of the world, that it is necessary to accompany any observations with specimens from the locality.

The occurrence of this common European plant in such small quantities in isolated localities on the American Continent, is very instructive, and obviously points to a period when the heath was a widely-spread social plant in North America as it still is in Europe, where oft-recurring fires are yearly lessening its range. The late Professor Edward Forbes, Dr. Joseph Hooker and Mr. Darwin, all agree in advocating a southern migration of northern types "due to the cold epochs preceding and during the glacial," and since Dr. Hooker has shown that the Arctic flora is essentially a Scandinavian one, there is no difficulty in finding in this theory an explanation of the way in which *Calluna* might have reached the eastern coast of America. There are, however, other explanations. At last meeting of the Institute, our President ever active in the cause

of science, showed us an extremely interesting specimen of a bird that is apparently fast following the Dodo, and may soon become extinct, if not so already. In *Calluna* we have probably an example of a species on the verge of extinction as an American species, while maintaining a vigorous and abundant growth in Europe. If so, may not Europe be indebted to America for *Calluna*, and not America to Europe? But I must not open up so important a question as the origin and history of our species, while so little is known of the botany of the Maritime Provinces of British America.

In a letter from Professor Asa Gray, of Harvard, October 4, 1864, to whom I had sent a specimen of the *Calluna* from St. Ann's, he remarks: "I am much interested in the smallness of the amount of the plant in your station,—just as in that in this State, —confirming my view that it is now a mere remnant of what was once more diffused."

Art. IV. Note on Lemania variegata of Agardh. By George Lawson, L.L.D., Ph. D., *Professor of Chemistry and Natural History in the Queen's University of Canada.*

[Read December 5, 1864.]

The correction of errors in science is a very slow process. In the first part of the second volume of Bishop Agardh's "Species Algarum," published in 1828, an alga said to have been found "in *fluviis Americæ borealis*," was described under the name of *Lemania variegata*. Agardh's original description of the plant appears, however, to have been published in the Stockholm Transactions in 1814, to which I have no means of access at the present time. The specimen upon which the species was founded had been given to Agardh by Olaf Swartz, his first master in Algology, who obtained it from the collector, the Rev. Dr. Muhlenberg, of Lancaster, in Pennsylvania. Not having been met with by subsequent observers, *Lemania variegata* has been looked upon as a long-lost plant.

In a parcel of specimens of cryptogamic plants sent to me in August 1862, by Mr. John Macoun, of Belleville, Canada West, a

*Read before the Botanical Society of Edinburgh, 9th April, 1863.

most zealous and successful explorer, I at once recognized a *Lemania*, remarkable for its extremely rigid, prominently monoliform, curved filaments, attenuated towards the base and apex, and regularly marked throughout by alternate bands, dark and white,—agreeing, in fact, very well with Agardh's description of *L. variegata*. I doubted not that the Belleville plant was conspecific with that of Agardh, and probably the identical form described in the "Species Algarum." Accordingly, I gave a description of the plant in the Edin. New Phil. Jour., N. S., vol. xviii. No. 1, July 1863. My description was scarcely published when an opportunity presented itself of my personally visiting the habitat for the Lemania, River Trent, along with its discoverer Mr. Macoun, and a careful examination led to a modification of my views. The plant is indeed apparently the same as that described by Agardh, but it is certainly not different specifically from *Lemania torulosa*, with which Harvey had indicated the probable identity of Agardh's plant (*in Nereis.*)

Lemania, Bory.

Generic character.—Fronds bristle-like, rising in clusters from a common adherent base, cartilaginous or corneous, continuously tubular, more or less nodose (brown, dull green, blackish or particoloured), the tube membrane composed of two distinct closely adherent strata of cells, those of the outer stratum minute, irregularly polygonal, closely united pavement-wise in radiating groups, those of the inner stratum rounded and not conformable, much larger than the others. Spores (so called by authors) in seriated stalked tufts, inside the swollen joints of the tube, and arising either from a central axis (according to Dr. W. J. Thomson), or from the inner peripheral layer of cells, or from both.

This genus, named *Lemania* by Bory, in honour of M. Lemain of Paris, "a modest naturalist not less learned in botany than in the other branches of science," embraces three species of aquatic algæ of very remarkable aspect and structure, which grow attached to stones, rocks, wood, &c., in the bottoms of shallow, rapid, fresh-water streams. Unlike most fresh-water algæ, they have dense, compact tissue, giving them firm consistence; they are rich in nitrogen, and when burned yield ammoniacal vapors. The plant

usually consists of a little tuft of stiff erect or curved bristle-like fronds, which adhere by a common discoid root to submerged objects. The minute structure of these plants has been illustrated very fully by authors at different times, from Vaillant (1727) downwards, with singularly conflicting results. The most recent and perhaps most valuable contribution that has been made to the history of *Lemaniæ*, is the remarkably lucid description of Dr. W. J. Thomson, in the Transactions of the Botanical Society of Edinburgh, vol. vi. page 243, to which I would refer observers as an excellent basis for further inquiry, although I have been unable (probably from my specimens being too matured) to confirm some of Dr. Thomson's results. Mr. Thwaites of Ceylon has carefully studied the early developement of the frond, and states that the spores at first vegetate into slender confervoid filaments, with long joints containing spirally arranged endochroms. The filaments constitute a sort of prothallus or pro-embryo, the initial state of the plant. After a time thick branchlets, the germs of the perfect and permanent frond, spring from the cells of the confervoid filament; they are at first wholly dependent upon the cell from which they rise, but soon acquire rootlets at their base, and, rapidly elongating, grow into the densely cellular, opaque, cartilaginous bristle-like tubes, so characteristic of the mature plant in this genus.

1. *L. fluviatilis*, internodes longer than nodes=(Confervia fluviatilis lubrica setosa, Equiseti facie, Horse-tail River Conferva, *Dillenius*, Hist. Musc., tab. vii. fig. 47. Conferva fluviatilis, *Linn.*, *Mohr*, *Roth.*, &c. Polysperma fluviatilis, *Vauch.* Chantransia fluviatilis, *DC.* Lemania corollina, *Bory.* Nodularia fluviatilis, *Lyngb.*) This is the more common British species which I gathered in quantity in a stream on the Ochil Hills, near Stirling, in 1857. It has also been recorded as growing near Bangor (*Dillenius*), in Winterbourne Stream, Lewes (*W. Borrer*); at Hamsell, and at the waterfall at Harrison's rocks (*E. Jenner*); Aberdeen, abundant (*Professor Dickie*, *M.D.*); Ireland, frequent (*D. Moore*); Scandinavia, Germany, France, Corsica; Sackville river, Nova Scotia, adhering to stones.
2. β. *tuberculosa* = (Nodularia fluviatilis ramosa, *Lyngb.*) Denmark.
3. γ. *media* = (Conferva fluviatilis, *Dillw.*, E.B., t. 1763). England.
4. δ. *fucina* = (Lemania fucina, *Bory*. Chantransia dichotoma, DC.) France, chiefly in Bretagne.
5. ε. *subtilis* = (Lemania subtilis, *Agardh*, in Act. Holm. 1814, t. 2, f. 4, Kutzing.) Sweden, &c.

6. *L. torulosa*, internodes equalling the nodes = (Conferva fluviatilis nodosa Fucum æmulans, Sea Horse-tail-like Conferva, *Dill.* Hist. Musc. tab. vii. fig. 48. Conferva torulosa, *Roth.*, *Mohr.*, *Dillw.*, &c. Lemania incurvata, *Bory.*) Recorded as occurring in mountain streams near Ludlow, Salop (*Dillenius*), Anglesea (*Rev. H. Davies*); also in France, Germany, Kentucky, United States (*Dr. Short* in Harvey, Nereis).

7. β. *usneoides* = (Conferva usneoides, *Wallr.*) Saxony.

8. *L. variegata* = (Hippuris fluviatilis petræa nuda Virginiensis, *Pluk.*) Belleville, Canada West (*J. Macoun.*) United States, Pennsylvania? (Muhlenberg).

Probably *L. fluv*, ε. *subtilis*, and *L. torulosa*, β. *usneoides*, may be found, on investigation, to be well-marked species. The various forms deserve a careful examination, and I would beg to direct the attention of British botanists to the subject.

Art. V. On the Land Birds of Nova Scotia. By A. Downs.

[*Read Jan.* 9, 1865.]

To the casual visitor, Nova Scotia would appear to be very deficient in bird life, and to a certain extent this condition is apparent even to the settler, for in certain seasons of the year and in winter, the interior districts seem altogether deserted by members of the feathered tribe. The lumberer will tell you that his monotonous life in the woods at the latter season, is rarely cheered by the presence of birds, and save and except the peeping cry of the black cap, and Hudson's Bay tit, and the brown creeper, with an occasional harsh note from the Canada jay, or a "chip" from the red squirrel, no sound beside the creaking branches of the maple, or the melancholy sough of the pine, is heard to break the death-like silence which reigns around. An English settler will not fail to notice the difference which exists between the scarcity of birds around his country house here and in the old country. Here a few blue birds or titmice are the only specimens seen about dwellings, while in England flocks of vociferous sparrows are feeding in the yard, and many a black bird, thrush, hedge-sparrow, and green linnet, haunt the garden and orchard, taking their toll from the gooseberry and currant bushes.

This scarcity of birds renders a residence in British North America by no means so pleasing as it otherwise would be, if the hours of early morning were enlivened by the merry chirpings of our feathered favourites; and although some may be inclined to think that the presence or absence of birds has little to do with our happiness so long as prosperity attends our worldly condition, they will surely acknowledge that the song of birds, attached as it always is to the season of summer, when the flowers exhale their perfume and the bursting leaves give fragrance to the breeze, tends to elevate our feelings, and make us realize the full benefit we enjoy in the contemplation of these pleasing scenes of nature.

It may not be out of place here to consider for a moment whether we should not derive benefit from the acclimatization of some of these household birds of England. Take the common sparrow for instance. What a treat it would be to see these saucy fellows preening their feathers on our roofs, and collecting in dozens round our doors to pick up the scraps, and I would even go so far as to say, gobbling up the cherries in our gardens; for who would not make a sacrifice of some kind, to colonize his domain with such a family of merry friends. It is often said that the cold of a Nova Scotian winter would soon kill the English bird; but how is it, I ask, that many of these birds are found in Germany and all parts of Northern Europe, where the cold is often as great as we have it here. Then the birds I speak of are more of a domestic type, keeping near dwellings, and apparently preferring the society of man. If, therefore, during the hardest weather we took care to feed them daily, as we do the poultry, our barns and outhouses and spruce thickets would afford them sufficient shelter at night. I think it is worth a trial.

In the following list it will be observed that no less than eighteen different species of true warblers visit us in summer. Some of these are remarkable for the beauty of their plumage, and even more so for their song.

To him who is blest with a desire to retire from the busy hum of men, and amid the seclusion of the forest to study in nature's school, a bright sunny morning at the end of May, when the hard woods are expanding their newly-formed leaves, presents a scene which no pen could properly describe. Flitting about from tree to

tree, these gaudy plumaged little songsters sing their melodious song, while the sunbeams dance in the shadowy glades, or flash upon the varnished leaves which rustle to the balmy western breeze. Up and down, round and round, chasing each other, darting from thicket to thicket, these merry little migrants from sunnier climes pursue in wanton playfulness their mates, or catch their insect prey; while at intervals they mount the topmost branches of birch or maple, and with distended throat and excited look pour forth their dulcet strains. Hard must be the heart of that man who is not moved at the scene around him, or as my worthy master in ornithology, Mr. Waterton, truly says in his ever memorable "'Wanderings in the South American forests'—heedless and bankrupt in all curiosity must he be, who cannot pause to look upon the towering mora tree, or listen to the distant bell note of the snow-white campanero."

But I fear my prefatory remarks are becoming too long and tedious. I will therefore pass on to my notes upon sixty-one different species of land birds, which will occupy my first paper upon the "Birds of Nova Scotia;" and should the present list prove interesting to the members of our Institute, I shall have great pleasure in following it up with others, and complete, if life and health be spared me, a perfect catalogue of all the birds that have been observed in the Province to the present time.

The Golden Eagle—(*Aquila chrysaetos*).—A specimen of this rare bird was taken in a fox trap uninjured, at Newport, in the winter of 1856. I first became acquainted with this bird in a garret, and he was so pugnacious, attacking Dr. Buskirk and myself with such fury, that I had to seize a broomstick to keep him off. Mr. Scarfe kept him for a year or more in a back yard opposite Mr. John Esson's, but at last he made his escape.

Bald-headed Eagle—(*Haliaetus leucocephalus*).—This bird is pretty common on the eastern coast of this Province. At Tangier their nests occur on the topmost branches of blasted pines and other trees. The nests are of large size and formed of sticks, and are always placed in an almost inaccessible position. This powerful bird when wounded throws itself upon its back on the approach of the sportsman, and with glaring eyes dashes out its huge talons with the utmost fury, rendering its capture by no means easy.

Some years ago, when I lived in town, I kept a pair of these eagles tame in my yard. One day Capt. Sir Richard Grant, R. N., came rushing in, in a great hurry, calling out—"Downs, your eagles are on the house and will get away," as he didn't know it was a common resting place for them. I afterwards gave these eagles to Capt. Dickson, the son of Sir Jeremiah Dickson, who many of you will recollect, and he took them to England with him. The female is extremely savage, for one in my collection when first taken at Tangier seized a child, and had killed several cats belonging to the miners. There is a dispute among naturalists as to whether there be two distinct varieties of this bird. The fact is, that the young birds do not assume the perfect plumage of white head and tail until the third year, and this immature state has no doubt given rise to the supposition. I am quite certain of the fact of the plumage requiring three years to mature, having one in my possession at the present time, which is just assuming the white head. In the month of June, some years ago, when that ardent naturalist the Rev. Mr. Torre, Secretary to Lord Falkland, was here, in company with him I visited the Shubenacadie, collecting specimens. We came upon the nesting place of these birds, situate on the precipitous cliffs beyond the Grand Lake. The young were sitting on the ledges of the rock high up, and screaming vociferously for food, which rendered the solitude of the place doubly felt. Thousands of night hawks were dashing over the river in chase of their insect prey as the sun was setting behind the dense mass of forest in the west, and as the wild notes of the birds echoed from the surrounding rocks, we stayed our paddles to rest for a while, and listen to this charming music of the wilderness.

Osprey—(*Pandion haliaetus*).—This bird is very common on our Atlantic coast, breeding in the vicinity of most harbours. I do not think that he ever troubles the settlers by making raids upon the poultry yards, as he appears to be a worthy inhabitant of Nova Scotia—a pure fisherman. Poising himself for a while in mid-air, he is suddenly seen to dash headlong to the water, and rise immediately with a large fish in his talons. This he carries to his eyrie, generally situated on the topmost branches of a storm-bleached rampike. If I were to state the quantity of sticks of which the nests of this bird is composed, you would surely think

me guilty of exaggeration, for an ordinary cart would hardly hold it. He sets a good example to commissariat officials in looking far ahead in the furnishing of his larder, so much so that it sometimes becomes offensive from the effluvia arising from the superabundant food left unconsumed. I kept a nest of the young of this species in my collection last year.

Ice Falcon—(*Falco Icelandicus*).—I only know of one instance of this bird occurring in Nova Scotia. This was taken at the mouth of the harbour here in an exhausted condition on board a ship, and died shortly after it came into my possession. This is more properly a European bird.

Goshawk—(*Astur Atricapillus*).—This bird is far too common—a perfect villain among poultry. Even a few days ago he carried off a beautiful little call duck belonging to my neighbour, Mr. Drillio; a pet pigeon from Capt. Hugonin, and also a call duck from me. I lost many fancy pigeons of great value last year by one of these birds; in fact every one, more or less, on the peninsula and about the head of the Arm, suffers annually from his depredations. I cannot invent a name bad enough for him. The young of this bird for the first year is so different from the adult, that many persons not well acquainted with the bird would consider these varieties as distinct species.

Rough-Legged Buzzard—(*Buteo lagopus.*).—Very rare, and only occasionally shot on his migrations to the north. It is a handsome bird, feathered to the toes. I once possessed a splendid specimen, which I stuffed.

Red-tailed Buzzard—(*B. borealis*).—I have a living specimen of this bird in my possession now. He was taken in the garden at the Ordnance Yard, in the act of seizing a pet crow belonging to Mr. Pengelley. A soldier caught him in his hands. One day the Chief Justice brought Mr. Livesey out to my place, and on my telling the former that I had tried and condemned my specimen for attempted murder, Mr. Livesey said "he has evidently made a bad use of his talents (talons)."

Red-shouldered Buzzard—(*B. lineatus*).—This bird is of rare occurrence. I have only seen two specimens.

Hen, or Marsh Harrier—(*Circus Hudsonicus*).—This bird appears to have the widest range of any hawk known, being found

in all parts of Europe, Asia, Africa, and America, even to the Equator. It is always known by the white rump, which occurs in all changes of its plumage from youth to maturity. In habit it is cruel, though cowardly, searching everywhere for victims, but selecting them only from weak and helpless objects. It preys upon moles, mice, young birds, and is very destructive to young game: nor does it spare fish, snakes, or even worms. I once took two green snakes from the crop of one of these birds. The slender body and elegant shape distinguish this species from others of the genus.

Pigeon Hawk—(*Falco columbarius.*)—This species is common in Nova Scotia, breeding in all the wooded parts of the colony. It is not troublesome to the farmer, only feeding upon the smaller birds. On my recent visit to Boston, while on my passage about half way across the Bay of Fundy, while I lay sick in my berth on board the "Delta," I was suddenly hailed by Mr. Cunard, who said a live bird had just come on board. Refreshed by the intelligence, I jumped up on deck, and found a sailor with a beautiful little pigeon-hawk in his hand, which had been taken in the rigging; General Doyle called for some meat, a portion of which he consumed. Unfortunately, after my putting him into a box, a steward, while feeding him, pulled one of the laths off, and just as we made Cape Ann, our little friend flew up the gangway and hasted ashore—thus getting his passage free, all found.

Sharp-shinned Hawk — (*Astur fuscus*). — Common. Breeds all over the Province. Like the pigeon hawk, it does not molest the poultry yards, being too weak and puerile to attack large prey.

Sparrow Hawk — (*Falco sparverius*). — Savage and bold in habit, this little bird, swift of flight, attacks even a canary at the cottage window. It is happily not very common. I once raised a nest of young ones, four in number, which afterwards died. Its plumage is very rich—black, brown, and white, deeply marked and distinct.

Hawk Owl—(*Strix funerea*). — This bird is in some years very abundant in winter time, but may not be seen again for four or five years. It is common in Newfoundland, where it breeds in the cariboo districts. I have often kept living specimens in confinement, taken sometimes on board the Cunard steamers off the coast.

Great-horned Owl—*(Bubo Virginianus)*.—I have now in my collection two of these birds, which I have had for several years. The female is a very fierce bird, and has a certificate of bad character nailed on her cage. She murdered her husband, and ate him, and from her dignified deportment has been named by visitors "The Lord Chancellor." She is black with murder, treason, sacrilege, and crime, and was presented to me by Mr. J. M. Jones.

Snowy Owl—(*S. nyctea*).—This bird is common here in winter, and breeds in Newfoundland. It appears that in some winters these birds traverse the North American continent in flocks. Last winter they made their appearance in great numbers in different parts of Canada.

Barred Owl—(*Syrnium nebulosum*).—This bird is a resident, never migrating from the colony. It breeds in the woods in all parts. It feeds on hares and ruffed and spruce grouse. The eye of this species is round and bluish-black in colour, while all the other owls have yellow eyes. This is the bird that disturbs the midnight slumber of the moose hunter and lumberer, coming near the camp fire and peering into the glare, which gives it a demoniacal appearance. Distending its throat and pushing its head forward, it gives vent to an unearthly sound, which to the superstitious is all but overcoming. While moose hunting some years ago, a colored man of kindred taste, by name Cornelius Toliver, one evening at the camp fire while listening to the hooting of this owl, related a superstitious tale regarding the appearance of his brother's wife after death, a circumstance of which he seemed greatly in dread.

Long-eared Owl—(*S. otus*).—Very rare in the colony, but is flushed occasionally when sportsmen are woodcock shooting.

Short-eared Owl—*(S. brachyotos)*.—Occurs here but rarely. I have a specimen which was taken alive on board the R. M. S. *Canada*, off Cork, Ireland, about two years ago.

Tengmalmi's Owl—(*Noctua Tengmalmi*).—Not common here, but abundant in Newfoundland. I stuffed two of these pretty little birds for a passenger in the "Osprey," who brought them to me alive, having captured them on board that ship off Cape Ray.

Acadian Owl.—This bird is known to the Indians and settlers as the "saw-weet," from its emitting a cry somewhat like that word. Capt. Bland, R. E., and Mr. George Piers had a living

specimen of this bird which they put into a room with a live rat. He immediately attacked and killed the rat, but died shortly afterwards, having apparently overtaxed his strength in his efforts, which will not be wondered at when we consider that the weight of this little assassin is but two ounces and a copper.

Whip-poor-Will—(*Caprimulgus vociferus*).—This bird used to breed here regularly near Hosterman's mill at the head of the Arm. I once heard one crying by my pond close to the house at midnight; but alas! from causes unknown, we no longer hear the plaintiff cry of the Whip-poor-Will. Waterton, speaking of this bird in the forests of Demerara, under the name of "goatsucker," thus proceeds—"The harmless, unoffending goatsucker, from the time of Aristotle down to the present day, has been in disgrace with man. Father has handed down to son, and author to author, that this nocturnal thief subsists by milking the flocks. Poor injured little bird of night, how sadly hast thou suffered, and how foul a stain has inattention to fact, put upon thy character! Thou hast never robbed man of any part of his property, nor deprived the kid of a drop of milk." When the moon shines bright, you may have a fair opportunity of examining the goatsucker. You will see it close by the cows, goats, and sheep, jumping up every now and then under their bellies. Approach a little nearer,—he is not shy, "he fears no danger, for he knows no sin." See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them as fast as they alight on the belly, legs, and udder of the animals. Observe how quiet they stand, and how sensible they seem of his good offices. Were you to dissect him and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd.

Night Hawk—(*C. Virginianus*).—This very common bird breeds on all blueberry barrens throughout the colony. It rarely visits us until the warm weather of June arrives, and departs for the south before the first frosts of autumn arrive. They lay two pretty mottled eggs on the bare ground.

Spine-tailed Chimney Swallow—(*Hirundo pelasgia*).—Very common, building its nest in a chimney formed of little sticks, glued together with a glutinous substance, somewhat like the edible bird nests of China.

Purple Martin—(*H. purpurea*).—This bird visits us every summer, but does not appear to like the place, as we are perhaps too near the sea coast. I have offered it every opportunity for breeding, to no purpose. When our Institute visited Windsor, at its first field meeting in the summer of 1863, I saw some of these birds looking for a convenient place to nest in about the Clifton House; and I am sure they would breed there if suitable boxes were provided for them, as they appear to delight to breed about inland hotels in the United States, where they are always provided with martin houses. In the western States, the Indians put up hollow gourds on poles for their accommodation.

White-bellied Martin—(*H. bicolæ*).—Breeds freely in boxes at my house and Halifax. It is the earliest swallow we have, arriving here about St. George's day. It is not gregarious in habit.

Cliff Swallow—(*H. fulvus*).—This bird is very different in its habits from the latter species, building its nest of mud, while the other uses straw and feathers. It also likes the society of its fellows, always building in company in positions like the Dockyard, old Barracks, Province Building, and Dartmouth church, from which latter place I am sorry to say it has been driven away by having its nesting places built up. What would Waterton say to such inhospitality? I saw this bird breeding about the cliffs of the rocks overhanging the Shubenacadie, in numbers.

Bank Swallow—(*H. riparia*).—Not found about Halifax, but is plentiful about the shores of the Basin of Minas, where it builds in the banks. Mr. Torre shot one for a specimen when entering its hole to feed its young. We counted about two hundred flies in its mouth and throat.

Barn Swallow—(*H. rustica*).—Is very common, breeding in most of the barns of the country. It is a good architect, like the cliff swallow, building a mud house for its young.

Belted Kingfisher—(*Alcedo alcyon*).—This is a very common bird all over the Province. It builds its nest in a bank, high above the water at the end of a tunnel about two feet long. It lays six fine pearly white eggs. It pays frequent visits to my pond, sitting upon the dead branch of a tree, from which it occasionally makes a plunge for a fish. I think this bird might be kept in confinement, like the Laughing Jackass of Australia, another member of the

genus. The note of this bird is very similar to the "whir" of a watchman's rattle, and is more frequently emitted during the breeding season.

TYRANT FLY-CATCHER, or KING-BIRD—(*Muscicapa tyrannus*).—Inland, but rare on the sea coast. At Londonderry, Windsor, &c., it is by no means a scarce bird. They are very useful on farms as watch-birds, driving away hawks from the poultry yards. This bird ought undoubtedly to be carefully preserved by all farmers, for he may well be termed "the farmer's friend." He also feeds on noxious insects. Poor Alexander Wilson paid a tribute to his worth in a poem, the language of which is so touchingly beautiful, that apart from all his other publications it is sufficient to raise him in the estimation of all kind-hearted people.

GREEN-CRESTED FLY-CATCHER—(*M. Acadica*).—Frequents the woods, and is generally seen in company with the warblers. It builds a little hanging nest, usually suspended between the fork of a small branch, and lays four white eggs.

AMERICAN REDSTART—(*M. ruticilla*).—This beautiful bird is very common, arriving generally about the 10th of May. It is called by the settlers "gold-finch." By no means shy, this little fly-catcher presents a showy appearance in our woods. Several pairs breed every year near my house, forming nests similar to those of the green-crested fly-catcher. Waterton found this species in the winter season in Demerara, but never knew where it bred.

RED-EYED VIREO—(*Vireo olivaceous*).—Very common. It used to breed plentifully in the hardwood groves at Purcell's Cove, but I grieve to say that the fishermen living there have cut down nearly all the trees for fuel, and the poor Vireo has to seek for another home. His note sounds like "Whip Tom Kelly," constantly repeated all day long.

CANADA FLY-CATCHER—(*Myiodioctes Canadensis*).—This species usually arrives about the 10th of May. Its colour is olive green with a black cap. It is always found with the warblers, and appears to be a connecting link between the warbler and fly-catcher.

NOTE.—There is another large species of fly-catcher which I cannot make out. It frequents the barrens about Grand Lake and Lawson's Mill. It is very solitary in habit, and does not make its appearance until the summer is well advanced. The coloured man Toliver, mentioned before, was generally hailed by his children when the first note of this bird was heard, with—"Daddy, here summer's come."

Great American Shrike—(*Lanius borealis*).—This bird is common in winter time, and is very daring, attacking even canaries in cages at a window. I think it breeds north, as it is not observed here in summer.

Robin, or Migratory Thrush—(*Turdus migratorius*).—Of this bird I need say but little, as all people, old and young, are cheered by his presence and song in spring. It also enlivens the homes of the Newfoundlanders at the same season. Arrives here about St. Patrick's day; a few stop with us all winter.

Hermit Thrush—(*T. solitarius*).—Common, although not generally observed. Its sweet yet melancholy note, given from the top of a spruce, late in the evening, induces the settlers to name it "*the nightingale.*" It lays four eggs of a blue colour in a nest on the ground, formed of dry grass and small roots, and is generally placed under the shade of the ground juniper.

Olivaceous Thrush—(*T. olivaceous*).—This species may be readily taken for the last. It makes a far different nest however, building in trees; the egg is also very different in colour. Its plumage is more of an olive green, while the former is of a rich brown.

Cat Bird—(*T. felivox*).—This is a common bird, but does not arrive until the summer is well advanced. It breeds in the alder swamps about the Dutch Village, and lays four blue eggs. Some of my neighbours have several of these birds in cages at the present time. It is the best song bird we have.

Golden-crowned Thrush—(*T. aurocapillus*).—Very common in the wooded districts, but hardly ever seen in the open. It builds an oven-shaped nest, and lays four eggs. Its note is loud and rapid and makes the woods ring with its echoes. In habit it is shy and solitary.

Water Thrush—(*Cinclus Americanus*).—This species is found about the margins of solitary lakes in the woods, and appears to delight in running in the shallows, searching for water beetles and other insects. It has long and slender white legs well suited to its habits, which are somewhat similar to those of the water wagtails of England.

American Pipit—(*Anthus Ludovicianus*).—This bird generally arrives here on its way to the south about the 20th September, and

only stays a week or ten days. It may frequently be observed about that date on the stone walls around "the common," constantly wagging its tail up and down. It feeds upon insects and small seeds.

SHORE LARK—(*Alauda alpestris*).—Generally arrives here from the south about the end of March, on its way to the north. It breeds in Newfoundland.

RED-POLL WARBLER—(*Sylvicola petechia*).—This is the pioneer of the genus *sylvicola*, arriving here about St. George's Day, even while the snow remains upon the ground. It makes its nest in a little mossy hillock in swampy places in the woods.

YELLOW RUMP WARBLER—(*S. coronata*).—This is the next visitor, arriving about the 1st of May. It builds its nest at the top of a pine tree, and lays four little blotched eggs. It is very common; handsomely marked with lemon yellow on the head, buts of the wings, and rump. Many people call it a goldfinch.

BLACK-POLL WARBLER—(*S. striata*).—Rare. I have shot but few specimens, and know nothing of its habits.

BAY-BREASTED WARBLER—(*S. castanea*).—This species is not very common, and frequents pine woods.

CHESNUT-SIDED WARBLER—(*S. ictero-cephala*).—This gay little warbler is very common in the birch groves, flitting from tree to tree, pouring forth its love song in the breeding season.

HEMLOCK WARBLER—(*S. parus.*).—Only one specimen of this rare visitor has fallen under my notice, which I shot near the "rocking stone" at Kidston's.

BLACK-THROATED GREEN WARBLER—(*S. virens.*)—Abundant in pine woods. Its note sounds like "a little bit of bread and no cheese." Have never found the nest of this bird.

CAPE MAY WARBLER.—(*S. maritima*).—Very rare. I have only seen one specimen, which I shot at Dartmouth some thirty years ago. I still have it in my collection.

BLACKBURNIAN WARBLER—(*S. Blackburnia*).—Observed on the hardwood hills about Grand Lake, but never about the sea-coast district. It is one of the handsomest of the warblers which visit us.

YELLOW-POLL WARBLER—(*S. æstiva*).—I have shot a few specimens of this bird about Kidston's, but know little of its habits.

YELLOW-BACKED WARBLER—(*S. Americana*).—This is another rare species, occurring inland in hardwood districts. I have shot

several specimens; always perched on the tops of the highest maples and other hardwood trees, over brooks of running water.

Black-throated Blue Warbler—(*S. Canadensis*).—Occurs rarely about Grand Lake. Have never shot more than two specimens.

Black and Yellow Warbler—(*S. maculosa*).—Abundant in all the wooded districts; arriving about the 10th of May.

Blue-eyed Yellow Warbler.—This familiar little warbler breeds in the vicinity of dwellings, generally in a gooseberry or lilac bush. It is of great service to the garden, consuming vast quantities of green caterpillars and insects. It is very fond of willow trees, and generally observed in such positions.

Blue-green Warbler.—This species is very rare.

Mourning Warbler—(*Trichas Philadelphica*).—Of this species I have only obtained one specimen, which I shot at the "rocking stone," near Kidston's, four years ago.

Maryland Yellow-throat—(*T. Marilandica*).—This pert little fellow has a good deal of the habit of the "Jenny Wren" of England, dodging in and out of a faggot heap. During the breeding season it has a habit of rising in the air singing, and drops down again like a stone. It generally builds at the foot of an alder bush, and successfully raises a large family.

Nashville Warbler—(*Sylvicola rubricapilla*).—I have always observed this species singing on the very topmost branches of trees. It is very wild and difficult to shoot, and is not very common.

Having now arrived, gentlemen, at the end of my present list, I must state that all the facts I have given may be safely relied upon, as they are the result of forty years' experience in bird life. And I would here, as it is the very first time I have ever appeared as a reader in public, take the opportunity of counselling the young men of Halifax to take more interest than they do in the natural history of their country. Many an hour now passed in walking up and down Granville Street in tight boots, might be devoted far more profitably to studying the quiet scenes of nature. If I had listened to the advice given me by the young men of my time, I do not think I should have had the pleasure of appearing here this evening; and instead of being happy, as I now am, in the presence of my brother

naturalists, and possessed of a cheerful home to which I can retire, surrounded by my feathered favorites, I should most probably either have descended to an early grave, or been the habitual frequenter of the tobacco and dram shops. No; the country for me, before all the grandeur and pleasure of the town. Old Waterton once said to me, he would sooner be in the woods than in the finest palace in Europe.

Art. VI. Observations on the Sea-birds frequenting the coast of St. Margaret's Bay, N. S. By Rev. John Ambrose.

[*Read Jan'y* 9, 1865.]

For the convenience of persons wishing to make enquiries of our fishermen, or desirous of obtaining specimens from them, I give the names by which they distinguish the sea-birds with which they are familiar, together with the scientific equivalents of those names, so far as I have been able to identify them :—

Loon—(*Colymbus glacialis.*)
Sea-duck—Eider—(*Anas mollissima.*)
Bottle-nose Drake—King eider—(*Fuligula spectabilis.*)
Coot, black—Common Scoter—(*Anas nigra.*)
Coot, bottle-nose—Surf Scoter—(*A. perspicillata.*)
Parrot—Puffin—(*Mormon fratercula.*)
Murr.
Turr.
Lord or Imp—Harlequin duck—(*Anas histrionica.*)
Cockawee—Long-tailed Duck—(*A. glacialis.*)
Hag-down—Manx Shearwater—(*Procellaria Puffinus.*)
Shell-Drake—(*Anas tadorna.*)
Red-breasted Merganser—(*Mergus serrator.*)
Grey Dipper.
White Dipper.
Black Duck—(*Anas boschas.*)
Common Teal—(*Anas Crecca.*)
Sea Pigeon.
Little Auk—Rotche—(*Uria minor.*)
Storm Petrel—(*Thalassidroma pelagica*).
Canada Goose—(*Anser Canadensis.*)

BRENT GOOSE—(*Anser brenta.*)
COMMON GANNET—(*Sula Alba.*)
SHAG—CORMORANT—(*Phalacrocorax cristatus.*)
SADDLE-BACK GULL—(*Larus Marinus.*)
LARGE GREY GULL.
MACKEREL GULL—(*L. argentatus.*)
WINTER GULL—(*L. leucopterus.*)
SEA GOOSE.

This list is by no means complete, as there are many birds less frequently seen on the coast, of which I have not yet obtained specimens or reliable accounts.

The main body of these birds spend the winter far to the westward of these shores; but a large number of stragglers of almost the whole list (of the duck and gull species) remain over winter, and furnish an agreeable variety to the larder, and a luxurious substratum as well as covering to the beds of our fishermen. On every fine day towards spring, especially if slightly hazy, as before a thaw, when the sea is smooth, from daylight till dusk, a continual popping is heard all around the Bay, and the far-off dot-like boats with their puffs of smoke add an enlivening effect to our winter landscape. Then the murr shooter is busy, for murrs at this season of the year seldom fly, but strive to escape by diving. The fowler, provided with one or two old militia muskets, an ox-horn full of cannon powder, and a bag of duck shot, sits amidships in his skiff, facing the bow. Pushing the oars, he quietly approaches the murr within thirty or forty yards, and fires. If the shot fails, the bird dives and comes up a hundred yards or so further off, is again approached as before, and so on until finally secured.

Our sea-birds begin to return eastwardly to the breeding places in the following order:—eiders about the middle of March; young coots and young eiders (*i. e.* birds not a year old), puffins, murrs, turrs, long-tailed ducks, harlequin ducks, loons, sea-pigeons, and shell-birds, about the last of March. Old coots a week or so later than the foregoing. By the last of June all birds of the duck species have passed.

They mostly fly with a fair wind, though not a day passes without some travellers during the migrating season. The largest numbers keep off at distances varying from four to eight miles from the ordinary coast line, so that the largest flocks are clear of danger,

and only the smaller ones pass close by the outside capes and headlands. Consequently, Green Island affords the best shooting, Iron-bound Island, off Chester Bay, the next best, then the outside ledges at the west side of the mouth of this Bay, where many birds stop to feed on shell-fish. The inside flocks then make a straight course for Peggy's Point, thence fly directly to Betty's Island, off Prospect,—a very few passing within shot of the islands off Dover.

The young birds, both of the eider and scoter species, viz., such as are about pairing for the first time, do not as a general rule fly with their seniors, but prefer going in flocks by themselves. Whether this arrangement is dictated by prudence on the part of the old birds, or impatience of controul and a desire for congenial society among the young, its consequences prove that the largest liberty is not always the best thing for youth and inexperience. Urged by the instinct of reproduction towards the sunny islands of the north, the young birds take the shortest routes, pass within reach of the fowlers' shot, and many pay for their impatience with their lives. "*Festina lente*" is a lesson towards housekeeping most frequently learned by painful experience, by men as well as birds on our shores. Early marriages among the thriftless and unprovided lead to much misery among our fishing population.

The food of most of the duck species seems to consist mainly of shell-fish, principally mussels, which they obtain from the various outlying ledges. I say most of the duck species, because some—such as "shell-birds," murrs, and turrs,—like the gulls, live mostly on fish. And here we observe the provident care of Him who openeth His hand and filleth all things living with plenteousness. Birds living on shellfish and weeds are furnished with a broad, flat, strong bill, suitable for detaching and crushing their food. Others, such as shell-birds, which live on both small shells and fish, have the bill narrower and stronger, as well as sharper in the curved edges at the sides. Others still, such as turrs, and gulls, &c., which feed on fish alone, have the bill narrow, sharp at the sides, and generally with a downward curve at the point, for the better seizing and securing the slippery and struggling prey.

Sea-birds, much more than land-birds, are inclined to straggle from the main flocks and deviate from general rules. The migratory thrush is almost the only straggler among our land birds

that I have observed remaining behind the main body in their autumnal migrations. But, as I before observed, almost our whole list of sea-birds are given to straggling habits in autumn. And in spring, whilst the main body go far north-east to breed, a few grey gulls, murrs and puffins, breed on our shores. Tradition would show, however, that the majority are reformers, whilst the minority are such as hate vulgar innovations, are content to "let well-enough alone," and stick to old systems, regardless of danger. Old settlers affirm that these shores formerly abounded with sea-birds, and that our outlying islands were the breeding places, not only of almost all the existing species, but also of one which, by the description given me by the late Michael Publicover, of Blandford, I take to have been the great auk (*Alca impennis*). But as men and guns began to multiply, the birds found it necessary to resort to less frequented places to the north-east. So it has been also with the fish of these waters. Danger has altered their habits, and it is only those which "learn nothing and forget nothing," that among our birds and fishes retain unaltered the institutions of more ancient times and safer circumstances.

The names given to our sea-birds by the fishermen are mostly descriptive, as indeed all names of distinction should be. The puffin is called the parrot, because of the similarity of its bill to that of the latter bird. The cock-a-wee is so named from its gabbling note, which sounds like this name. In some parts of the Province it is called the old squaw, from the ludicrous similarity between the gabbling of a flock of these birds and an animated discussion of a piece of scandal in the Micmac language, between a number of antiquated ladies of that interesting tribe. The harlequin duck is called a lord, on account of the gay plumage of the drake. It is also known as the imp, because of the difficulty of shooting it. The little auk is called the bull bird, from the shape of its head and neck. It frequents our coves in the dead of winter and towards spring, and rarely flies, but endeavours to escape pursuit by diving. It is the favourite game of boys, more eager for the pleasure of a shot than solicitous as to the cost of ammunition.

The boatswain is always found in company with his betters, the larger kind of gulls, who by no means relish his society, but vote him an intolerable bore. His habit is to pursue the gulls through

the air until they drop their excrement, which he catches and devours ere it reaches the ground. He is consequently looked upon with much contempt by our fowlers, but enjoys the usual immunity of meanness, for the gulls are shot and eaten, whilst he is suffered to escape.

The hag-down is seldom found near the shores, but like the sea-goose keeps off at a distance of not less than six or eight miles. In dark and foggy weather both kinds come in occasionally, the sea-goose particularly, about the end of June. Hag-downs, like petrels, are very fond of scraps of fish or meat thrown overboard by the fishermen, who thus lure the birds to their destruction, the hag-down flying so close to the boat as to be easily knocked down with a sprit or oar. They are very tenacious of life, and like Irishmen may be "kilt" many times by the blow of a stick, and yet recover. They are killed mostly for the sake of their feathers. The bodies are generally thrown to the pigs, though some persons manage to eat them, as they eat gulls and cormorants, by skinning before cooking them.

The birds most highly prized for food are eiders and coots, or scoters. These are shot in large numbers at Iron-bound and Green Island by the help of decoys. The ingenuity displayed in the manufacture of these decoys is very creditable to our fishermen. They are made of pine or spruce, neatly shaped, and not unfrequently covered with the skins and plumage of the birds they represent. They are attached to each other by pieces of codline of various lengths, so that on the water they are distributed by the winds and currents, exactly in the manner and at the relative distances of their living prototypes when swimming at their leisure. The two families on Iron-bound place these decoys in good positions for shooting, immediately before the arrival of the first flocks of birds. For some days not a gun is fired on the island, nor a loud sound heard. The birds, arriving and finding everything still, and flocks seemingly of their own kind already in possession of quiet and desirable places for food and rest, exchange caution for emulation, call a halt, and at once settle down. Then begins the work of destruction. The decoys are quietly drawn in towards the shore by the fowlers, who with muskets and large water dogs are carefully concealed behind the rocks nearest the shore. The ducks follow by

degrees, until a large number are well in, and then, sitting and rising, receive the deadly welcome. The water is stained with blood, and covered with the bodies of the slain, and the air is rent with the flapping and quacking of the survivors, and the barking of dogs ere they muster courage to rush into the half-frozen water and secure the floating, swimming, and sprawling game. In this manner, during the easterly passage of the birds, hundreds are secured by the people on Iron-bound alone. I am credibly informed that during the vernal and autumnal flights something over two thousand birds were shot on this island in 1863. The greater part of the game is sent to Halifax, Lunenburg, and the neighboring places for sale, whilst the feathers bring from thirty to thirty-five cents a pound.

The people of Peggy's Cove shoot from their boats, lying off in a line extending seaward from Peggy's Point. I have seen in a morning in spring as many as fourteen or fifteen boats thus lying off, at the distance of a little more than a gunshot apart, tossing on a sharp "lop," or slowly rising and falling on a southerly swell. Two men go in each boat, one to fire and the other to keep the boat in position by short strokes of the oar, which is called "drumming." The wind is south-west, or west, the weather is hazy, and the birds, seizing the opportunity of a fair wind and obscurity, fly from headland to headland in large flocks. To our unpractised eye, as we stand on the cliff, no bird is visible; but the urchins around suddenly exclaim "there's a bunch comin'!" They come straight on; but presently discovering the nearest boat, sheer slightly, rise much higher, and pass between two other boats. Bang! bang! is the salute, and you see the disabled suddenly tumble with hanging wing; others reel on their course, try for a moment to keep up with the increased rapidity of their companions, but fall here and there at short distances from the boats.

From daylight until eight or nine o'clock in the morning the firing continues, and in the height of the flying season, at intervals throughout the day.

Sometimes these excursions are attended with excitement of a different kind. Two of our fishermen, tempted by the abundance of game, remained so long outside one squally morning, that at length a heavy sea filled the boat, sweeping the men overboard.

They were rescued by another boat's crew with much difficulty, having lost everything in their own boat.

Two others were coming in, on another occasion, after a morning's shooting, when they saw a heavy sea approaching. "Hold on!" said one, "and we shall get a runner." But the sea, instead of running them in towards the shore, broke upon their boat, and washed one overboard. The other threw him an oar, leaving himself but one, by which the boat was unmanageable. Another boat, however, rescued both men from their perilous situation.

A boat's crew on these shooting excursions will generally bring in from two or three to twenty or thirty birds, according to the position of the boat and the skill of the fowler. But at points further out along the coast, such as Green Island, Horse-shoe Ledge or Betty's Island, as many as forty or fifty birds are not unfrequently brought home by one boat in a morning.

At the first settlement of the shore, birds were much more numerous than at present. As the population increased, the number of birds fell off rapidly; but this decline was at length discovered to proceed more from the club than the gun. For many years vessels had been allowed to load with sea-birds' eggs at the various breeding islands between Nova Scotia and Labrador, through the entire period of incubation, and this egg-gathering was too frequently attended by the wanton and wholesale destruction of the parent birds. From the beginning of the breeding season to the end of it, these islands and rocks were continually visited, all fresh eggs were taken away, and all stale ones broken. At length some wholesome and necessary restrictions on the egg trade were put in force by the Canadian legislature, since which time the birds, though more wary, are not decreasing in numbers so rapidly as formerly. A future generation will see the necessity of reasonable protection for the reproduction of birds and fish, and necessity may inspire the firmness requisite for the impartial execution of such protective edicts.

The shooting of sea-birds is not only a source of profit to our fishermen, and a means of providing them with an agreeable variety at their frugal board, but it also relieves a great deal of the tedium of their winter season of inactivity. It is surprising, however, that accidents do not more frequently happen from their mode of charg-

ing their guns. Three fingers of powder and two of shot is the smallest load for their old militia muskets—the approved gun here,—and in the hurry of loading in a boat much more powder is frequently poured in. Black eyes and bloody noses are the not uncommon penalties of a morning's sport, and I know one fisherman whose nose has been knocked permanently out of shape by the frequent kicking of his gun. In several instances the gun has gone clear overboard out of the fowler's hands, by the recoil. But nothing can daunt these men, or induce them to load with a lighter hand. There is one living at Nor'-west Cove, who has had his right eye destroyed by his gun, but who is now as great a duck-shooter as ever, firing, however, from the left shoulder.

Many of these people have a strong belief in the potency of charms and incantations, in connection with shooting, and consequently would lose all confidence in themselves, and all ability to take aim, with a "charmed gun." A man formerly lived at La-Have, who enjoyed the reputation of being able, with a glance, to pervert for a time the shooting qualities of any gun. Not unfrequently did this fear of his evil eye induce other sportsmen to withdraw, leaving him all the shooting of the occasion. The same superstition exists among the African tribes, so far proving that the negro is "a man and a brother."

A singular proof of the adaptation of instinct to necessity, is found in the manner in which sea-birds of the duck species attempt to escape when on the water and unable to fly. They will swim for long distances just so much below the surface of the water that the end of the bill as far as the nostrils is the only part of the body exposed to the air. Many in this way escape the most careful pursuit. It seems to me more than probable that this art has been acquired since their acquaintance with man, the only foe whose "far-darting" destructive power, and inability to see the operation from above, makes such a mode of escape at once necessary and practicable.

Crippled birds resort to retired coves and out-of-the-way nooks, where they remain until fully recovered. Some are wing-broken and unable to fly, others are maimed in the leg or foot and can not dive, but He who careth for the fowls of the air is their provider, and very many of them get the better of their wounds. There is a

favourite resort for wounded birds between Peggy's Cove and Dover, which is thence called the "hospital." There is also a well-known "hospital" for sick and wounded fish about a quarter of a mile outside of Peggy's Point. It is a narrow gulch or ravine with a muddy bottom, thirty fathoms deep, bounded on each side by a sort of rocky cliff fifteen fathoms from the surface. Healthy fish, observing ordinary rules, are found on the rocky bottom at each side of this ravine, but in the muddy valley itself none but the sick and wounded are taken. There they are caught of large size, but what are called "logy fish"—many of them wounded with deep gashes, not such as are generally made with any of man's contrivances, and all wretchedly thin. On either side of this hospital hake will not take bait in day time, but in the "sick bay" itself—"*necessitas nullas habet leges*,"—they will bite at all times. They are hungry, and therefore likely convalescent, but not sufficiently strong to defend themselves or take their ordinary prey at proper seasons outside.

Art. VII.—Some Additions to the Game of Nova Scotia. By J. H. Duvar.

(*Read Feb.* 6, 1865.)

"Natural History in the olden time" would be an excellent subject for the pen of any member of this Institute, who combines with his knowledge of Natural History a taste for dipping into history proper. In following his liking for the latter pursuit, the naturalist would stumble on records that would astonish the scientific men of the present day. While it is impossible to withhold our meed of admiration from the early travellers and missionaries who, led by the spirit of adventure, or zeal for their order, made their way into the most savage lands, and brought back not unfaithful accounts of manners and customs, it is yet astonishing how credulous they were in all that pertained to natural history. I have in my possession a tracing of a Jesuit map of Lake Superior, made in 1670, which agrees in almost every detail with the modern chart, yet of the same date, when their topography was so reliable, the reports of the good fathers on animated nature were

not such as have been confirmed by later investigations. In these days of minute and exact research, it may not be uninteresting, from the stand point to which the waves of progress have wafted us, to pause and look back to the landmarks that indicate the ebb and flow of the great ocean of Truth, on the shores of which this generation and those past have alike been picking up shells.

Navarette, for instance, describes, in the empire of China, an alligator, three fathoms thick, in which were found three men's heads, with some daggers and bracelets. Nevertheless there was an herb which enabled the possessor to ride this formidable creature with safety, as Waterton rode the cayman. The unicorn is described, among other qualities, as being "a merciful beast." The mermaids of the Gambia are reputed, when fried, to resemble pork. A singular efficacy against falling sickness resides in the leg of the elk, *which* leg is discovered by knocking the animal down, and observing with which foot he scratches his ear. There is a variety of goat in Nankin, that has ears and nose, but no mouth, and lives upon the air. A still more extraordinary animal must be described in the author's own words. "There are two other strange and remarkable creatures in China. The one is called *Lang;* its forefeet are very long, and the hinder ones short. The other beast is named *Poei*, or *Poi*, whose hind feet are long and the fore feet short, whence it follows that they cannot go singly apart from one another. Their Maker taught them how they should go from place to place to feed and seek their sustenance. Two of them join, and one helps the other, so that one sets down the long fore feet, and the other hind feet, so they make one body that can walk: thus they get their food and live. The Chineses call miserable poor wretches that cannot live by themselves *lang poi*, to signify that they want some assistance to get a living. This is not unlike a lame and a blind man, one finds eyes and the other feet, and then they help one another and walk." The same or another observer met with a fowl the size of a chicken, which laid, a yard deep in the sand, eggs "bigger than the bird itself, so that no man living would judge that the eggs could be contained within it." In the vegetable kingdom, the curate of Labaun saw a tree whose leaves falling to the ground turned into mice. And in Lower Germany are found on the sea shore trees whose leaves, dropping into the water, are converted into ducks.

These examples may suffice to mark the distinction between the natural observers of two centuries since and those of even this little Institute,—being, as it is, an outlying post, or rather vidette, on the extreme edge of the intellectual field of the century.

Coming down from these worthy travellers who trustingly accepted the most incongruous appearances as merely so many manifestations of the Creator's power, through the later periods of close observance and accurate classification, we find that the studies of the naturalist in the present day are mainly given to utilize the mass of facts which he and his predecessors have garnered up; hence acclimatization, fish-culture, improvement of domestic stock, and search for animals and plants that may contribute either to man's wants or luxury.

The geographical distribution of animal life does not strictly follow the isothermic lines of the globe. Hence there is an increased range for stocking the temperate zone with the products of other zones, especially of the warmer belts, which are more prolific of varieties than the colder, and, moreover, it is well recognized that animals adapt themselves better to change of climate when removed from a higher to a lower degree of temperature, than from a lower to a higher. This fact indicates to us more than one inhabitant of southern latitudes, which, by a little attention, might be induced to naturalize in our colder air;—the alpaca, for instance, which, already imported into Spain, finds on the slopes of the Pyrenees the summer and winter climate of Nova Scotia. M. Saint Hilaire* very learnedly shows that man, who calls himself the lord of creation, is really lord of only forty-seven specimens, all told, of beasts, birds, fishes and insects. His list is interesting. Here it is, omitting the dates of domestication:—

Mammalia: The Ox, Buffalo, two varieties of Camels, Goat, Sheep, Zebu, Yak, Lama, Alpaca, Reindeer, Arnu, Joyal, Horse, Ass, Dog, Pig, Cat, Guinea Pig, Rabbit, Ferret,—total, twenty mammals.

Birds: The Pigeon, Poultry Fowl, common Pheasant, Peacock, Game Fowl, common Duck, Swan, Ring Turtle-Dove, Chinese Goose, Canary, Turkey, Muscovy Duck, Golden Pheasant, Silver Pheasant, Ring Pheasant, Canada Goose,—sixteen Birds.

Insects: The Mulberry Silkworm, Bee of southern Europe,

* Acclimatation et Domestication des Animaux Utiles.

common Bee, Egyptian Bee, Cochineal, Almond Silkworm, Ailanthus Silkworm,—seven insects.

FISHES: The Carp, Goldfish,—two fishes.

REPTILES: None.

Total, 21 mammals, 16 birds, 7 insects, 2 fishes—46 in all, instead of 47.* Of these 47, M. St. Hilaire says fifteen are wanting in France and thirteen in Europe;† and he adds, "is this a sufficient conquest of nature? Is it enough to have in our court yards only three species so valuable as that of the gallinaceæ?—or only one of the rodentiæ, so remarkable for its fecundity, the precocity of its development, and the excellence of its flesh? Among the large herbivorous mammalia, is it enough to possess only four alimentary species?" I would add, is it enough for our sportsmen to possess, in a Province such as Nova Scotia, of which so large a portion must ever remain in lake, moorland and forest, so few varieties of swimming, flying, and running game?

It will be noticed that M. St. Hilaire's catalogue of domesticated animals is more than arbitrary, and somewhat less than complete. Some of the animals mentioned can only, by a latitude of language, be said to be domesticated, while others, equally under the subjugation of man, are omitted from the list. The immediate business of this paper is not, however, with the domestic animals of man, but with the semi-domesticated or "GAME," which, living untended in our wilds, supply the sportsman at once with amusement and food. Not to trespass on time, I will do little more than indicate such as might find in Nova Scotia the conditions of climate, covert, and food, and by reproduction increase the number and varieties of our objects of the chase. Of course, it would be a mistake to introduce any new game until the legislature and the people at large have found the way to preserve what we have. The Inland Fisheries and Game Protection Society, recently organized, have taken the initiatory step, and it is to be hoped that their endeavours will be seconded by the influential in the community, until the public

* The one omitted is probably the tench, introduced into Britain with the pond carp and goldfish. It may be the Pike, according to the old rhyme:

"Turkeys, carps, hoppes, piccarel and beer,
Came into England all in one year."

† Fourteen are wanting in Nova Scotia. The others, including the gold and silver pheasant and the common English pheasant, adapt themselves well to the climate. In lieu of the silkworm the cecrops is abundant.

mind is educated up to a proper pride in the maintenance of our forest life.

Taking the sportsman's definition of "fish, fur, and feathers," it is only among the Ruminants and Rodents that we can look for additions to our running game. Of the wolf we have but a rare visitor from the adjoining province of New Brunswick—and he, gaunt, solitary, and cowardly. Our hunters always know where to find a bear, or a loup-cervier (vulgar: *lucifee*). Moose and cariboo, if let alone, and especially if the Legislature would prohibit their being hunted for the next four years, would largely increase. But other furs are few. Naturalists, rather than sportsmen, must determine whether the white hare of Newfoundland, found also in this Province, is identical with the prolific Scottish mountain hare, or wherein either may differ from the bold and agile Irish hare *(lepus Hibernicus)*. Should they be of different species there yet appears no reason why all should not thrive here. The common English hare (*lepus timidus*), would manage to maintain itself in the highly cultivated western portions of the Province, but as the thrifty farmers of that region would not care to burden themselves with its feed, there is not much hope of seeing it domesticated among them. Besides, the hare, as an object of pursuit, belongs to what may be called the advanced stage of sporting, and would serve, mainly, as an inducement for the breeding of the greyhound, "the regent of dogs,"—a title which, whether applied to his sagacity, courage, docility, and susceptibility of instruction, extending even (contrary to general opinion) to the education of his nose, experience of the animal amply verifies. Here let me mention, incidentally, that where the hare will find a form the English skylark will live, to cheer the sportsman's heart with its song. There is probably not one acclimation that could be more easily made in the agricultural districts of Nova Scotia than the songlark. The geographical range of the bird is extensive—from Southern Europe to Siberia. Larks can be bought in quantity in either England or Germany at trifling cost, and would survive the voyage hither. The grey rabbit or burrowing hare (*lepus cuniculus*), is another introduction that would naturalize itself, and would, doubtless, increase in a more rapid ratio than its enemies. Specimens of the house or domesticated rabbit, have escaped from con-

finement near Halifax, and have been afterwards seen, earning apparently a honest livelihood.

Suffering as our country is from the want of protection for its game, it may be too sanguine to hope for any increase in the variety of our deer. In wooded, sheltered and enclosed parks the fallow deer might be reared as an ornament to grounds, although unfitted to range for itself in the woodland. But the ordinary American or Virginia deer (*Cervus Virginianus*) has its range from the Gulf of Mexico to the borders of New Brunswick, increasing in size and beauty as it approaches the north. There can, therefore, be no possible hindrance to the introduction of this really valuable game into our coverts, where, according to the opinion of our best sportsmen and most practical naturalists, it would multiply and increase. The beautiful and hardy little roedeer of the Scottish highlands (*Capreolus capræ*) is another most desirable accession, nor do I think it would object to make itself a habitat in the fir copses of our secluded forests. A year or two of experimental acclimatization within enclosures would prove its adaptability for the woods.* Another of the deer family which would, probably, naturalize more kindly, is the "wapiti," or Canadian elk (*Elaphus Canadensis*—Ray,) of which Sir John Richardson gives the northern range as the 56th or 57th parallel of north latitude. Previous to the late unhappy war in the States, the Wapiti was semi-domesticated in many parks in Virginia. The king of Italy has imported a herd which are reported here to have taken kindly to the hills of Lombardy. Beyond the ruminants named, the chances of increase to our deer are unlikely. Attempts have been made in the United States to extend the range of the pronghorn antelope and Pacific blacktail deer, under climatic conditions more favorable than ours, but without success.

In birds, there are a few likely to prove additions to our game, all being of the sub-family of the *Tetraoninæ* or grouse. Commencing with the true ptarmigan—the *lagopus albus* of Linnæus—there could be little difficulty in introducing this fine although rather sluggish bird on our higher barren grounds. A member of the Institute states that it does exist (rare) on our hills. Indeed

*I have lain out, in Scotland, on the watch for these pretty creatures in weather quite as cold as it is in Nova Scotia in ordinary winters.

it ranges on the mountains from Iceland to the Alps.* Everywhere in Nova Scotia are to be found those rugged granite wilds such as are its haunts in Scotland and Norway. The severity of our climate is not greater than its European experience. In summer, it would find varied sustenance on the moors, and in winter the birds, like other winged game, would sustain themselves with their proper food of buds, berries and leaves of trees. As they associate in flocks and may be taken in snares, there would be but slight difficulty in importing a sufficient number to experiment upon. A yet finer bird than the ptarmigan is the capercailzie (*Tetrao urogallus*), the very king of feathered game. This splendid fowl is still common in Sweden and Russia, and could be, and ought to be, a splendid addition to our birds of the chase. As it lays from eight to a dozen eggs, and the young are hardy as well as active in foraging for themselves, three or four years' protection should suffice to form the nucleus of a preserve, especially as man would be the chief enemy so large a bird would have to fear. An importation from Norway could be made without extraordinary expense. Should we ever have an acclimatization society in this Province, or should it fall within the scope of the Society for the Protection of Game, the capercailzie would probably be the first importation to which they would turn their attention with hopes of success. The black grouse (*Tetrao tetrix*) is another pleasing game bird, susceptible of naturalization here. The black grouse could live on the edge of our swamps and cranberry or blueberry barrens, and would put through the winter on juniper and beech buds and mast. For most part of the year they are wary, and afford capital sport. The principal British bird of game has yet to be noticed—the grouse proper (*lagopus scoticus*), the red grouse, locally called the muirfowl or gorcock. There are great doubts whether it would be possible to stock our barrens, even were its haunts as rigorously preserved as are the moors at home. True grouse seem to thrive nowhere but among the Scotch heather, the bells of which form their principal food,—although I have shot these birds when they were pilfering oats from late reaped fields on the edge of the moorland. Considering the almost impossibility of protecting them in a wild state, at the same time that they are quite susceptible of

*It is also found in Newfoundland.

domestication, they will not likely be ever found to multiply in Nova Scotia except as denizens of the aviary, or among the fancies of the poultry yard. Here let me contradict an error that is still going the rounds of English sporting works. In the "Field Book of the Sports and Pastimes of the British Islands," by the author of "Wild Sports of the West," (a recent edition,) it is stated, under the head of "American game," "The American grouse is precisely like the Scotch grouse. There is only here and there a place where they are found; but they are in those places killed in vast quantities in the fall of the year."* Every body on this side the water knows that the American grouse—or partridge so called —are the birch† (*Tetrao umbellus*) or ruffed grouse, and the spruce spotted, or Canada grouse, both different from the red grouse of the British Isles.‡

As regards the family of pheasants, much may be said in their favour. The English pheasant (*phasianus colchicus*) has escaped from confinement and survived the winter in Nova Scotia. Golden and silver pheasants, now kept for luxury, have proved themselves capable of enduring the severest frosts. Indeed there are many varieties of pheasants, which, with the spread of agriculture in the future, may become the game of the country, and supersede, in the hedgerows and coppices, the now wilder winged ones of the woods.

One more splendid variety of game must be mentioned, which would multiply and flourish exceedingly, but the hope to see it in our woods is too utopian for this century. This bird is no other than the turkey; the half-bred bronzed being probably the best. We read that a flock of 2,000 were kept in Richmond Park in the time of George II., for the especial shooting of that monarch, but as the public surreptitiously joined in the sport, they were destroyed. The only drawback to their being naturalized as wild game in this Province is, that while one could be found, none of our backwoodsmen would want for a dinner.

Proceeding to the finny tribe:—

From the greater capacity of fish for bearing extreme variations of temperature, and from their adapting themselves so easily to

* See Field Book, &c., page 9: London.

† It is the birch partridge (male only) that "drums."

‡ The willow grouse of Newfoundland, and the prairie hen, or pinnated grouse, have also been suggested to me, but I cannot speak of them from personal knowledge.

variations in the state of their natural element, whether it be rapid, sluggish, clear, or turbid, we should probably succeed with fish more surely than with any other game. Perhaps it is treason to hint that Nova Scotia is not so good a fishing country as many others. Several new varieties of fish have to be reared as stock on our aquatic farm before we can boast of much variety for *maigre* days. Omitting such of the game fishes of Europe and elsewhere as are manifestly unsuited to the Nova Scotian element, there are several of the *salmonidæ* that deserve passing enquiry. Thus the *salmo hucho* of the Danube, attaining the length of two feet, has attracted the attention of English fish-breeders. It can live wholly in fresh water; but as it is the most predatory of the tribe, the wisdom of introducing it here into our limited range of lakes may be questioned. The *salmo ferox*, or great lake trout—not to be confounded with the *salmo eriox*, or bull trout—is well adapted to our larger lakes, such as Rossignol, Grand Lake, &c, as it reaches nearly the weight of the true salmon (*salmo salar*), but does not migrate to salt water.* It is found in all the mountain lakes of Scotland, Switzerland and Norway, and even in ponds without running water. It is decidedly ferocious. I am unable to say what relation the European fish bears to the great American lake trout, found in lakes Huron and Erie, but not in Ontario. Richardson, an American naturalist, calls the cis-Atlantic fish the *salmo Naymagush* (an Indian appellation), and describes its average weight as double that of the true salmon. Another of the tribe is named by the same authority, as the lesser lake trout, or *salmo adirondacus*, of four to six pounds weight, which does not rise, but is taken by trolling in deep water—therein differing from the Irish gizzard trout, or *gillaroo* (which answers its description), but which *does* rise to the fly, although its main food is small shell-fish. Yet another American member of the *salmonidæ* is found in New Brunswick, and is called the Schoodic trout; in appearance like a "grilse," origin doubtful, being supposed by some to be a hybrid between the salmon and salmon trout.† It is permanent in the fresh water of the St. Croix River, and in the Schoodic lakes. It is called by Girard the *salmo Gloveri*. The delicate vendise or ven-

* Col. Sinclair, A. G. M., captured a specimen which seems identical with the *salmo ferox*.

† A very unlikely circumstance.

gis (*salmo marenula*) known as the fresh-water herring in Scotland, Switzerland and Silesia, would doubtless thrive here, as there, in deep shaded lakes. So would the char, which inhabit the lakes of the Tyrol. Mr. Astley Baldwin,* a pleasing writer on fish and fishing, recently remarks : "a new species of salmon trout has lately been brought to perfection on the continent (Europe). It does not grow to a considerable size; it is, however, very palatable, and commands a good price. The name bestowed on it is *salmo salvelinus.* This fish is being introduced into the Danube, one of the best rivers for fish of all kinds in the whole of Europe."

The Danube is at present a source from which many fine varieties of fish are being drawn for propagation, among others, the huge *siluris glanis*, which reminds me that forty years since Sir Humphrey Davy, in his "Salmonia, or Days of Fly-fishing," speaking of that river, says :—

"The four kinds of perch, the *spiegil carpfen* and *siluris glanis*, all good fish, and which I am sorry we have not in England, where I doubt not they might be easily naturalized, and where they would form an admirable addition to the table in inland counties. Since England has become Protestant, the cultivation of fresh water fish has been much neglected. The *barbot* or *lotte*, which already exists in some of the streams tributary to the Trent, and which is a most admirable fish, might be diffused without much difficulty, and nothing could be more easy than to naturalize the *spiegel carpfen* and *silurus;* and I see no reason why the *perca lucio perca* and *zingil* should not succeed in some of our clear lakes and ponds, which abound in coarse fish. The new Zoological Society, I hope, will attempt something of this kind; and it will be a better object than introducing birds and beasts of prey."

After this extract from Sir Humphrey, time need not be wasted in particularizing other less important varieties of fish desirable for our waters, such as varieties of the bass, tench, and carp, and the most recent English suggestion of the mountain mullet from Jamaica.‡ Suffice it to say that none of the above suggested additions to our game would be subjected to any new climatic or physical conditions were they imported into Nova Scotia. The main objections are the expense and the difficulty of protection.

With permission let me conclude this paper by reference to a

* Once-a-week, Decr. 24, 1854.

† Salmonia, page 258, Lond. 1828.

‡ The yellow perch (*perca flavescens*) will live every where in Nova Scotia, and wherever that useless fish is now found, the black bass (*centopristens nigricans*) would flourish, as also the striped bass, which although a sea-fish is said to thrive and even to improve by being cut off from the salt water. The loch bass, another variety, has found its way from Lake Champlain, through the canal, into the Hudson, and plentifully stocked that river.

desirable importation, (a crustacean,) which though not game itself, is nevertheless a capital addition to a game supper, the *cancer pagurus*, or large edible crab so abundant on the shores of Britain, especially along the east coast of Scotland. Nothing could be easier than to stock our seaboard with this excellent shell-fish. The writer chanced about three years ago to be the fellow-passenger to Europe of some tubs of live lobsters, which were sent from the shores of Maine, *via* Halifax, to the emperor of France; and thought at the time it would be a good thing were the tubs returned to the governor of Nova Scotia, filled with live crayfish and edible crabs, in return for the lobster salads the French savans have doubtless ere this enjoyed from lobsters native to the coast of Acadia.

By the way, there is one other fish which ought to abound in every brook and rivulet, viz., *Leuciscus phoxinus*, or true minnow. They have only to be thrown into any suitable water to increase and multiply for the angler's use. They may be drawn from several of the streams near Halifax to stock other breeding places.

In a pleasing book by an American sportsman occurs the following passage, not inappropriate to the subject of this paper:—*

"There is a very erroneous impression, encouraged too, shame to say, that the wild creatures of the woods and waters must, in the nature of things, disappear before man. Now, although this is a lamentable fact, it is not a necessary consequence, and there is nothing in man's capturing fish and killing game, properly and reasonably, that will seriously diminish their numbers. Fish and birds prey on one another: for every large trout a man takes he saves a hundred small ones; for every hawk he catches hovering over his barnyard and hills, he saves a hundred quail, and thus, although he kills them himself, he preserves them from vermin, from one another, and from birds of prey. If he will add to this a very little care and protection of the young, he will increase the supply a thousand fold."

In conclusion, I have only to add, that an increase in the number and variety of our game must be an object of interest to every one who takes pleasure in out-of-door life, and, I think and hope, is alike within the province of the sportsman and the naturalist.

Let me hope that these imperfect notes may lead to more practical investigation, and tend, in a slight degree, to show the value, as preserves, of our forests and rivers, in which the game at present is so mischievously and wantonly wasted.

* Game Fish of the North: New York, 1862.

Art. VIII. The Production and Preservation of Lakes by Ice Action. By Thomas Belt.*

[*Read Feb.* 6, 1865.]

During a residence of two years in the Province of Nova Scotia, my attention was directed to the multitude of lakes, great and small, that are spread over the country, sometimes in connected chains, sometimes isolated on the tops and sides of hills, &c. These lakes form a common feature in the northern parts of America, and increase in number as we proceed northwards. The larger lakes are shown in maps of the Provinces, but it requires a visit to impress on the mind the number of small lakes and ponds that abound in every direction. Mr. Perley, speaking of Newfoundland, says :—

"The most remarkable feature of Newfoundland is the immense and scarcely to be credited abundance of lakes of all sizes. * * These are found universally over the whole country, not only in the valleys but on the highest lands, even on the hollows of the summits of the ridges and on the tops of the highest hills. These ponds vary in size from pools of fifty yards in diameter, to lakes of upwards of thirty miles long and four or five miles in width. The number of ponds which exceed a couple of miles in extent must on the whole amount to several hundreds; those of smaller size are absolutely countless."

My duties in connection with the management of some mineral properties in Nova Scotia, took me almost daily along the line of an important chain of lakes, which, stretching almost across the Province, had been taken advantage of by the Shubenacadie Canal Company to form a water communication from the Atlantic coast to Cobequid Bay, by connecting the different lakes with short canals. The works of the canal company exposed in many places the structure of the enclosing strata, and showed that most of the lakes were in true rock basins; and I had opportunities whilst mining operations were being carried on on the banks of one of the lakes, of studying the disposition of the heaps of boulder clay and gravel piled up on its sides.

The rocks in which the lake basins lie are chiefly extremely hard quartzites and metamorphosed schists, supposed to be of lower silurian age, although as yet no fossils have been discovered in them. They are irregularly covered with heaps of boulder clay, mostly unstratified. Wherever the surface of the rock is exposed, it is found to be scratched, grooved and polished; and other marks

* Read before the Geological Society, June 22, 1864.

of intense glaciation, such as the rounding of protuberant bosses of rock, and the transportation of huge boulders, are of frequent occurrence. The course of the main lines of scratchings varies from N.N.E. to N. N. W., and the lines of the major axes of the lakes and of the chains of lakes, have the same bearings. The Shubenacadie lakes commence at Dartmouth, near Halifax harbour, and stretch in an irregular northerly direction to the head of the Shubenacadie river, a distance of twenty-two miles, and with the river they occupy a great depression or valley, running from Cobequid Bay to Halifax harbour, a distance of fifty miles.

The largest of the chain, the Grand Lake, is eight miles long, and in its deepest part its bottom lies seventy-four feet below the mean level of the sea. The coast is indented with long, narrow, deep bays or fiords, running in the same direction as the chains of lakes. The glaciation of the rocks and the transportation of boulders point to the agency of ice, and the only question undecided is, whether we shall ascribe them to the action of glaciers or of icebergs. Icebergs, laden with rocks and clay, and ploughing up the bottom of the sea where they grounded, might be sufficient to account for the scratchings and for the transportation of boulders; but they do not furnish us with the power requisite to scoop out deep channels and gorges, often continuous for scores of miles, in hard rocks, which are as characteristic of a glaciated country as the minor scratchings and groovings. In Nova Scotia, the whole country has been hugely grooved and furrowed, and heaps, or rather hills of gravel, piled up on the sides and in the courses of the channels excavated. This configuration of the country is best explained, as it has been by Agassiz and others, by supposing that it was covered by a vast accumulation of continental ice, moving southward from the Arctic regions, which, when at its greatest development scooped out the larger vallies and deep fiords, and modelled the grander features of the country; and during its retrogression, when continental ice enveloping the hills had wasted into glaciers down the principal valleys, they, during their slow retreat, left terminal moraines in their courses, and heaps of gravel and angular blocks on their flanks.

It is readily admitted that such lakes as are formed by the damming up of channels with heaps of clay and gravel, may have been

formed by glaciers leaving terminal moraines in their retreat, and the scooping out of long deep channels is easily understood; but the production of deep rock-basins is not so easily explained, and their glacial origin has been disputed by eminent geologists. We owe the theory of the production of rock basins by ice action to Professor Ramsay, who in 1859 showed that there was an intimate connection between mountain lakes and the evidences of glacial action, and argued that the rock basins had been ground or scooped out by ice, either in soft rocks surrounded by harder, or more generally, in places where a greater height of ice had accumulated and exerted a greater grinding pressure on the rocks beneath. In 1862 he extended his theory to account for the production of the great lakes of Switzerland, and even those of North America, contending that there is such a gradation of size from the least to the greatest that we cannot apply the theory to the one and not to the other.

The Lake of Geneva is 984 feet deep, the Lake of Zug 1279 feet, and the Lake of Brienz more than 2000 feet, and its bottom about 200 feet below the level of the sea. In Italy even these depths are exceeded, and we have the Lake of Como 1929 feet deep, and the Lake of Maggiore 2625 feet, and its bottom 1940 feet lower than the sea level. With regard to these great depths it has been urged by Sir Charles Lyell and others, that though the passage of prodigious masses of ice for ages over the surface would doubtless produce depressions where the hardness of the rocks beneath was not uniform, yet a depth would soon be reached where the movement of the ice in the basins would be arrested, and the discharge of the glaciers would be over and not through the ice-filled hollows. In a glacier as in a river, the lower strata move much more slowly than those at the surface, being impeded by the friction on the bed of what we may call the ice river—and as in the Lake of Maggiore the ice, on Professor Ramsay's theory, would have in its exit to ascend a slope of five degrees from its deepest part. It is contended that in such a case it would be simply dammed up, the glacier passing over it. It is true that in Australia there are deep hollows in the courses of the streams, in which water is stored up during the dry season, but this is a peculiarity of intermittent rivers and dependent upon the intermittent action. Again,

in British North America, great holes are gradually worn during winter in the sleigh tracks, commencing at first with slight depressions in the hardened snow, and increased by the passage of every sleigh, until the holes become so deep as greatly to inconvenience travellers; but here again the action is very different from the steady continuous flow of glacier ice, the scooping out power depending on the sudden descent of the sleighs into the hollows, which, in the case of glaciers would be filled with ice.

Sir Charles Lyell considers that the great lake basins of Switzerland have not been scooped out, but that they are all due to unequal movements of upheaval and subsidence during the great oscillations of level since the commencement of the glacial period.* But whether or not this theory is sufficient to explain the formation of the great lakes of Switzerland and Italy, it does not apply to those of British North America, nor of northern Europe, where we have lakes of all sizes, increasing in number as we proceed northward, and found everywhere along with and evidently part of the glaciation of the land. It does not explain this palpable connection of rock basins with glacial action, and in seeking for another solution we naturally turn our attention, first of all, to that agent whose power has been so conspicuously displayed in the erosion of the deep valleys and fiords of glaciated countries.

These considerations have lead me to endeavour to solve the main difficulty in accepting Professor Ramsay's theory, viz.: the immense depths of some of the basins; and I think it may be shown that even if the ice were dammed up at moderate depths, it would still possess great grinding powers, which would be augmented instead of being diminished by increased depth. In the first place I must draw attention to a feature of all glaciers, the streams that issue from beneath them. In Switzerland, from the bottom of every glacier, rushes a torrent densely charged with mud. It is the same with the great glaciers of the Himalayas—the Ganges, the Pindur, the Kuphinee and the Thlonok, rise from beneath glaciers. The flow of water diminishes in winter, but never entirely ceases in glaciers of the first class. In Greenland, Dr. Rink says, that "in some places mighty springs are seen to come forth from under the outer edge of the ice, pouring out clayey water in continued quan-

* Antiquity of Man, p. 316.

tity throughout the winter." * Most of the water issuing from the bottom of glaciers proceeds from the melting of the ice at the upper surface of the glacier, finding its way to the bottom through crevices and channels in the ice; but a not inconsiderable portion is produced by the melting of the lower surface next the earth. Professor Forbes made some careful observations on this point, and found that in summer the glacier wasted away by melting at the surface 3.62 inches daily, and by subsidence or wasting at the bottom 1.63 inches daily. The water that issues from beneath the ice in Greenland throughout the long and severe winter, can only proceed from land springs and from the melting of the ice next the earth. The only example of glaciers that do not give off water during the winter that I have been able to find, are some of those small ones on the higher parts of the Alps that have been called "glaciers of the second class," on which, from their altitude, the effect of the earth's heat must be very small.

Let us apply these facts to the consideration of the question of a depression in the pathway of a glacier, which has reached such a depth that the ice is not bodily discharged from it, but simply fills it, the glacier passing over the choked up hollow. We have seen that at the bottom and sides of the hollow, the ice would be slowly melted by the earth's heat, increasing with the depth of the basin; as the ice at the *lower end* of the basin melted the whole mass would be pushed along by the thrust of the moving glacier above it. Into the crevice at the upper end would pour the water coming down the bottom of the glacier from above the basin, which would pass underneath and be forced out at the lower end, carrying with it the mud produced by the crushing down of the ice as it melted at the bottom, and by the grinding along its floor as it melted at the lower end of the basin. The water coming from above would assist in melting the ice, especially in summer, but its most important effect would be the scouring out of the bottom of the basin, so that an ever clean face of rock would be presented to the huge tool operating upon it. That such an action, or a somewhat similar one, would take place at the bottom of an ice filled basin, with a glacier passing over it, and that it would be effective in deepening it, I cannot doubt. It would in some measure resemble the action of a

* Jour. Geographical Soc. Vol. 23, p. 153.

hollow drill that has been proposed for boring holes in rock through which a current of water is forced to carry off the ground stone, and still more, the production of pot holes on our coasts and in the hard beds of many rivers, by the moving water turning a stone in a hollow and so gradually deepening it, until through time a cylindrical and deep cavity is formed. A lake basin is an immense pot hole, in which the mass of ice that filled it took the place of the moving stone, its grinding power vastly increased, and in great part due to the moving glacier above it. The eroding action would be slow, but it would be continuous, and the only limit in depth to its power would be when the hydrostatic pressure of the water equalled the weight of the superincumbent ice, a limit far beyond anything with which we have to deal. The rock basins of Nova Scotia are much shallower than those of Italy and Switzerland, because in the one case the rocks operated on have been hard metamorphosed schists and quartzites, in the other soft molasse, easily eroded; the work done being proportional to the hardness of the material.

Art. IX. On some Brine Springs of Nova Scotia. By Henry How, D. C. L., Professor of Chemistry and Nat. Hist., University of King's College, Windsor, N. S.

[*Read March* 6, 1865.]

In a former communication to the Institute,* and in another paper,† read before the Natural History Society of Montreal, I have given the composition of some of the mineral waters of the Province, known or reported to possess medicinal properties. Nearly all those analysed had for their leading ingredient sulphate of lime, or plaster, as it is called, the exceptions being a brine from the neighborhood of the Renfrew gold diggings, and that interesting water from Bras d'Or, of which the chief constituents were common salt and nearly as much chloride of calcium. In the discussion which followed the reading of my paper at the Institute, several springs were mentioned as locally famous, viz., those of Earltown, Shubenacadie, and a place a mile and a half east of Shelburne; but I believe no facts bearing on the composition of

*Trans. N. S. Inst., Vol. 1. † Canadian Naturalist, Oct. 1863.

their waters were made known. As regards the waters yet examined, those adverted to above contain so much sulphate of lime, and so little of other substances, that they might almost be made to form a distinct group; and the Bras d'Or water is one of a very remarkable class,* called strongly saline, differing from brines in holding an amount of earthy chlorides equal or superior to that of common salt, which in true brines is of course the characteristic and exceedingly preponderating ingredient. It is well known that many of these true brines exist in the Province, but no analysis has yet been made, or at any rate published, of any of their waters. In the present paper, I give the results of my analysis of the waters of two brine springs (one of which I have made the subject of a communication to the Chemical Society of London), with information respecting the localities in which they rise, and place also upon record some notices of other brine springs with which I have been favored.

Brine Springs, Walton, Hants Co. My attention was drawn to one of these springs last May, when I was on a prospecting expedition in the neighborhood, by Mr. Joseph W. Stephens, who assisted me in collecting some of the water, and who subsequently kindly furnished me with interesting details of information. The spring issues on the west bank of the Petite River, a short distance from Walton bridge. It always has a considerable flow of water, which is clear and has no odour. The water has never been known to freeze; its temperature was 44° Fah. on a warm day in winter when the air was 46°. At all times in winter, even in the very coldest weather, there is about an eighth of an acre of the ice in the river quite soft and rotten, into which the spring water flows, and where the water actually enters the river it is never frozen. Mr. Stephens threw a piece of ice into the spring in January, and was astonished to see how rapidly it melted. The water is evidently somewhat thermal. It appears not to have been put to any medicinal use. The water collected by myself, having been kept in a well-corked bottle, was analysed in December, when it gave the following results: the imperial gallon contains —

* Geology of Canada, p. 563, and C. News, x, 181.

	Grains.
Carbonate of Lime	14.73
Carbonate of Magnesia (very small)	undet.
Carbonate of Iron	traces.
Phosphoric acid, decided	traces.
Chloride of Magnesium	4.48
Sulphate of Lime	161.16
Chloride of Sodium	787.11
	967.48

There is probably a small amount of chloride of potassium contained in the common salt, and it is quite possible also that there are traces of other constituents, which were not sought for in the small quantity of water at my command. A very interesting feature in this brine, illustrating the differences which obtain between the composition of waters as they issue from the earth, and that of the ocean which exhibits the results of numerous chemical changes, is the very large quantity of sulphate of lime present along with the salt, which, however, is still by so much the principal ingredient that the water is a true brine. In sea water, according to the elaborate researches of Forchhammer, extending to several hundreds of analyses,* the maximum ratio of chlorine to sulphuric acid and to lime *in the open ocean*, is—

100 chlorine to 12.09 sulphuric acid, and
100 chlorine to 3.16 lime;

in the Walton brine we have

100 chlorine to 19.7 sulphuric acid, and
100 chlorine to 15.4 lime.

This water in fact contains almost exactly as much sulphate of lime (161 grains) as pure water would dissolve (viz., 163 grains) if saturated. Since some of the waters of the Province, viz., those of Wilmot and Spa Spring, Windsor, to which curative properties are attributed, contain this substance as by far the most abundant ingredient, experience may yet show the Walton brine to be also valuable to invalids, although sulphate of lime has not, I believe, as yet been recognized as a useful medicinal agent.†

Brine Spring, Salt Springs, Pictou Co. For a quantity of water from this spring I am indebted to the Rev. A. McKay, who occu-

* Proceedings of the Royal Society, C. News, x, 293.

† Mr. Stephens informs me that on the other side of a ridge of land rising just above the Walton Spring just described, at a distance of two miles and a half, and on the descent of the ridge, a second brine spring is said to exist.

pies the Manse at the locality, and who kindly furnished me with the following information :—

"Last spring there was a great freshet, and the river made its way into the principal spring. I waited, expecting to have the river turned into its wonted channel, but being from home on a mission to Cape Breton at the time the river was lowest I did not succeed. There has been a hole dug in the end (?) of a low bank about nine yards from this main spring, by a company, about twenty years ago, who made salt from the water which came up there. This hole is ten or twelve feet deep. The water does not overflow here. From this spring I took the water sent to you. I also sent a piece of the rock jutting out between this hole and the main spring. There are several small springs about this low bank, over the length of about 150 yards. The salt water oozes out in many places along this course, and salt is deposited in some places.

"The water is used for rheumatism, and in so far as used I believe it has proved an effective cure. It is applied externally."

On examining the water, I found that there was a very large quantity of salt present, along with much sulphate of lime. When received (September 9th) the water was without odour, but on standing for some time it smelt strongly of sulphuretted hydrogen, from the reduction of the sulphate by organic matter. Under these circumstances, in order to obviate considerable error, the principal ingredients were estimated at short intervals, but of course, since an accurate analysis could not be made of a liquid constantly changing, I can only offer the following results as exhibiting the approximate composition of the brine. An imperial gallon contained—

	Grains.
Carbonate of Lime	3.775
Carbonate of Magnesia	2.932
Carbonate of Iron	.181
Silica	.560
Sulphate of Lime	154.730
Chloride of Magnesium	27.330
Chloride of Calcium	51.910
Chloride of Sodium	4133.500
Phosphoric Acid, Boracic Acid, Bromine, Organic matter,	undetermined.
	4374.918
Specific Gravity at 53° Fah.	1046.69

There was probably a small amount of chloride of potassium contained in the common salt. With regard to the bromine, the

evidence of its presence was very decided, the quantity was quite large enough to admit of determination, but the trouble involved in the exact estimation of this element is really so considerable that I contented myself with qualitative results. No doubt this valuable substance exists in other brines of the Province, but it has not before been proved to be present. It is from brines that most if not all the bromine of commerce is obtained. Boracic acid was found by evaporating somewhat less than a third of a gallon of the water, when it was perceived to exist in distinct traces. The presence of this acid is particularly interesting; it is probable or at least possible, that if due search were made most if not all the brine springs of this Province which rise in the lower carboniferous rocks would be found to contain it. I have already shown* the existence of boracic acid (in two minerals), and also of a small quantity of rock salt, in the gypsum of Windsor, and now we have the same association observed in water from rocks (most probably) of the same formation at a distance of some 60 miles. When I detected the borate in gypsum, the late Dr. Robb, of Fredericton, strongly advised me to search waters issuing directly from the plaster rocks for boracic acid: the interest attaching to such an enquiry is increased by the result now brought forward. Gypsum is often associated with rock salt in other countries, and it is found with boracic acid (in the mineral boracite) in Germany.

Brine Spring, Sutherland's River, Pictou Co. For information respecting this spring, I am indebted to Rev. Dr. Honeyman; the water issues in the bed of the river, so that it can only be got at in the dry season; the outlet is situated a little above the falls due to disturbance of rocks which are probably lower carboniferous. The spring was discovered by persons observing cattle to drink at it, and it is now much resorted to and its waters are drunk for a variety of diseases.

Salt Pond, Antigonish. Dr. Honeyman informs me that salt was formerly made from this pond, and that a bathing house exists here: the region is lower carboniferous.

Brine Springs at Whycogomagh, Cape Breton. Of these, Dr. Honeyman tells me there are two, of which one is medicinal and the other is employed in the manufacture of salt. They rise in

* Silliman's Journal, Sept. 1857, and July 1861.

lower carboniferous rocks, and at about a mile from the medicinal spring is situated the "salt mountain," supposed to be so called from a salt spring which issues from it. H. Gesner, Esq., informs me that this spring is not strongly saline. I learn from Dr. Honeyman that there is in this district another spring of a highly gaseous character, which is continually sending off bubbles of gas, carrying up a fine sand; its water is not saline but sweet to the taste.

Brine Spring, 12 miles from Bedeque. H. Gesner, Esq., informs me that a very strong brine, affording one bushel of salt to the hundred gallons of water, or six per cent. of salt, is found on the north side of the St. Patrick's Channel.

From what we see of the number and distribution of the brine springs of the Province, mentioned in this paper and elsewhere, the manufacture of salt may be expected to become a considerable branch of industry. The composition of the brines issuing from the lower carboniferous rocks is favourable to the manufacture, if, as may be supposed, they all resemble those of which the analysis has just been given, in containing sulphate of lime as the most abundant ingredient next to salt. As this is a substance not readily dissolved by water, it will separate almost entirely from the brine on boiling down to a certain stage, and the deposit on further evaporation will be table salt of considerable purity. Bromine of course, if present, will be found in the fluid from which the salt has deposited.

Art. IX. Enquiry into the Antiquity of Man. By Wm. Gossip.

[*Read March* 6, 1865.]

The evidence relied on by geologists who endeavor to carry back the antiquity of man to an era far beyond the historic, is gathered from strata of the tertiary period, in which, associated with remains of extinct animals, are flint implements and weapons, similar to those which are known to be of the recent period; and from cavern deposits, in which the remains of man are found, mingled with those of other animals, the species of which it is supposed did not come down to the chronologic or historic age.

Geology, however, reveals no data to establish positive conclu-

sions on this subject. There is ample room for speculation, and time and verge for almost every deduction that may be hazarded, and many of these are practically mischievous. It has already become a vexed question whether man was really created, or progressively developed from inferior forms of animal existence. Some philosophers evidently deem the record of his creation a fable. Others, among whom we may quote Sir Charles Lyell, attempt to show that man went back to, if I may so speak, or was coeval with the extinct animals, instead of their coming down to what we believe to have been his era; or they would lead us far beyond the sacred chronology to a period anterior to the glacial, and showing us vegetation similar to that which now prevails in temperate regions of the earth, and remains of quadrupeds which once lived and flourished upon it, bid us seek there, as if seeking we should find, for evidence of man's existence also. None, however, has been or is likely to be discovered. Nor does it seem probable, as the result of investigation, that the truth of the sacred record will ever be successfully disturbed.

It is to a few of these speculations, and the alleged proofs, which may be found at large in Sir Chas. Lyell's book "*On the Antiquity of Man*," that I would this evening direct your attention. I shall endeavour to show that the facts stated as evidence of human existence are not referable to the remoter period, but may all have been consummated in the chronologic era.

It is something gained in a cause like this, when the bias with which an author approaches his subject can be clearly demonstrated. If he truly believe that he can achieve a result, however distant it may seem, he will seldom hesitate to adopt every possible inference which he thinks may lead to it. Sir Charles Lyell has largely, whether justifiably or not, drawn upon the material at his command, for the purpose of making a nearer approach to his object. It would occupy too much of our time were I to allude to every instance; but I will quote one, which if it open up an extensive field of investigation, is well calculated to strengthen scepticism, and to lead astray from the legitimate area of enquiry, which as yet is far from being thoroughly explored.

There are in England two sets of strata, of marine formation, which seem to form a connecting link of the tertiary with the post-

tertiary periods. One of these belongs to the older pliocene, and is divisible into the coralline and the red crag—the coralline being the older of the two. The other belongs to the newer pliocene, more advanced in time as the term indicates, and is commonly called the Norwich, and sometimes the mammaliferous crag. I need not go into a lengthy and particular description of these formations, any one who desires that will find it in Sir Charles Lyell's "*Antiquity of Man*," and other works on Geology. It will suffice to state, that in them are a number of shells of recent species, the proportion of the recent to the extinct being greater in the newer beds. Thus, in the coralline or oldest crag, there is found fifty-one per cent of recent, in the red crag fifty-seven, and in the Norwich crag eighty-seven. These shells prove a progressive change in the climate. That of the coralline must have been warm, for twenty-seven southern shells are found, of species which now inhabit the Mediterranean and West Indies, and but two closely related to arctic fauna. Only thirteen of these southern shells occur in the red crag, together with three new southern species, but eight northern species are found, showing that the climate was less fitted to support some of the testacea that lived in the previous period, and becoming more suitable for the northern species. All the foregoing southern species disappear from the Norwich crag, but all the eight northern species remain, and four arctic shells are added. Thus is represented the increasing cold, the gradual approach to the glacial period of depression, although, in the time of the Norwich crag, probably there was no season in which the cold was intense.

Connected with the marine deposit of the Norwich crag, at a place called Cromer Jetty, where it thins out, is a submerged forest, which has been traced for more than forty miles, and which at one time must have had a considerable elevation above the sea. The Scotch fir, spruce fir, yew, alder and oak, are among the trees that are known to have grown in that region, and various extinct mammalia flourished there, of which numerous bones have been collected.

There is no doubt about the age of these respective formations. They belong most certainly to the older and newer pliocene strata, and the associated fauna are those which previously and probably

then existed, and roamed the forest now buried beneath the waters. But had remains of man been found there, the chronological record would not have been true. They have not been found, therefore positive evidence against that record is wanting, and so far the negative evidence proves its truth. Yet Sir Charles Lyell writes, with reference to the time of the Norwich crag: —

"Neither need we *despair** of one day meeting with the signs of man's existence in the forest bed, or in the next overlying strata, on the ground of any uncongeniality in the climate, or incongruity in the state of the animate creation with the well-being of our species. For the present we must be *content to wait*, and consider that we have made no investigations which entitle us to wonder that the bones or stone weapons *of the era of the elephas meridionalis* have failed to come to light. If any such lie hid in those strata, and should hereafter be revealed to us, *they would carry back the antiquity of man to a distance of time probably more than twice as great as that which separates our era from that of the most ancient of the tool-bearing gravels yet discovered in Picardy or elsewhere.* But even then the reader will perceive that the age of man, though pre-glacial, would be so modern in the great geological calender, that he would scarcely date so far back as the commencement of the post-pliocene period."

From this instance, which will show the scepticism, or if you will the positive belief, of the talented new school of geologic philosophy, you will gather the fact, that there are no evidences of man's existence upon the earth, in any formation or deposit, previous to the glacial period, nor have any traces of his existence that may be depended on been discovered in Europe until a long time after its close.

When scepticism is carried beyond the historical, chronological, and geological evidence, it need not surprise, that conclusions based on such scepticism are disputed. Sir Charles Lyell states in his book, that M. Desnoyers, an observer equally well versed in geology and archæology, had disputed the conclusion arrived at by other geologists (M. Tournal and Christol), that the fossil rhinoceros, hyena, bear, and other lost species, had once been inhabitants of France contemporaneously with man. "The flint hatchets and arrow-heads," he said, "and the pointed bones and coarse pottery of many French and English caves, agree precisely in character with those found in the tumuli and under the dolmens (rude altars of unhewn stone) of the primitive inhabitants of Gaul, Britain, and Germany. The human bones, therefore, in the caves, which are

* The italics are mine.—W. G.

associated with such fabricated objects, must belong, not to antediluvian periods, but to a people in the same stage of civilization as those who constructed the tumuli and altars." "In the Gaulish monuments," he added, "we find, together with the objects of industry above mentioned, the bones of wild and domestic animals, of species now inhabiting Europe, particularly of deer, sheep, wild boars, dogs, horses and oxen. This fact has been ascertained in Quercy and other provinces, and it is supposed by antiquarians that the animals in question were placed beneath the Celtic altars in memory of the sacrifices offered to the Gaulish divinity Hæsus, and in the tombs to commemorate funeral repasts, and also from a superstition prevalent among savage nations, which induces them to lay up provisions for the *manes* of the dead in a future life. But in none of these ancient monuments have any bones been found of the elephant, rhinoceros, hyena, tiger, and other quadrupeds, such as are found in caves, which might certainly have been expected had these species continued to flourish at the time that this part of Gaul was inhabited by man."

I quote this, not only to show that there is a wide difference of opinion among geologists of eminence upon the antiquity of human remains, but that Sir Charles himself, as he states further on, became of opinion, from the arguments of M. Desnoyers and the writings of Dr. Buckland on the same subject, and by visiting several caves in Germany, that the human bones mixed with those of extinct animals in osseous breccias and cavern mud in different parts of Europe, were probably not coeval.

This opinion, however, he limits, for he again states, "But of late years we have obtained *convincing proofs*, as we shall see in the sequel, that the mammoth, and many other extinct mammalian species very common in caves, occur also in undisturbed alluvium, imbedded in such a manner with works of art, as to leave no room to doubt that man and the mammoth coexisted." I am not inclined to dispute their coexistence, but I wish to offer my reasons for believing that it took place in the chronologic era, and not in time so far beyond it as to make the Bible a fable, and to scatter the foundation of our religious belief to the winds.

In the way that I am able to understand the geological evidence on the subject, it does not conflict with the sacred chronology, and

may be readily made to prove its truth; while all the argument adduced in favor of the remoter antiquity of man, if valid, must prove that chronology to be a falsehood. My ideas upon the subject tally more with those of M. Desnoyers than with Sir Charles Lyell's, although distinct from either. I acknowledge the truth as advanced in part by the former, but dissent altogether from the conclusions of the latter. At the same time, my solicitude is not on account of my own views, but lest those of Sir Charles Lyell should have more importance than they deserve. You know what he means —that he thinks he has good evidence in strata in which the remains of man are found with those of extinct species of animals, to prove not only the age of such strata, but also the coeval existence of man and the extinctions with which he there seems to be associated, and that man's proper time on this planet will thus be tens of thousands of years (it does not matter how many) further back than his first appearance in the Garden of Eden. I believe that in all this he is mistaken—that he takes things too much as he finds them, for the purpose of establishing a foregone conclusion, and attaches too little importance to the changes that have taken place on the earth during the past six thousand years. He ignores altogether such an event as the Noachian deluge, and the phenomena which must have accompanied and followed it. He does not allude to it, and his silence is more eloquent than words to show that he does not believe in it. I do believe in it, and depend upon it as strong evidence in disproof, and to uphold my own views, although I bring these forward with diffidence and great humility. They may or may not be entitled to examination. It is, however, an attempt in a safe direction, and it does not follow that some more efficient explorer of the arcana of nature, may not be privileged to reconcile the discrepancy if any, that prevails between the conflicting testimony of geology, as held by some, and what is generally termed revealed religion.

In the early period of man's history, there was doubtless the same migratory disposition as at the present day. We find it recorded that the eldest son of the first human pair, was the first emigrant. For the period of sixteen or seventeen hundred years between the creation and the Noachian deluge, we may suppose that offshoots were continually transplanting themselves, not only

from the parent stock, but from each other. As men separated from their fellows, they must have become divided into families, groups and tribes, just such as peopled the northern parts of America when discovered by Europeans—wanderers who had lost all trace of their origin and of the primitive civilization,—hunters and fishers—dependant upon the prolific sea, and upon the wild beasts of the forest for food and clothing. It is quite possible and probable, that before that event the northern portions of Europe, in the order of creation, had been peopled with animals of forms and species largely developed, fitted for a previous condition of the earth, but becoming gradually extinct under the operations of altered nature. These fading species would have been contemporary with man, have lived and died around him for ages, until he and they were suddenly removed from the scene by destructive agencies. It is to this buried world that I would direct your attention. If the Noachian deluge erased from the earth by a signal catastrophe all human traces from certain latitudes, and all traces of other animals that existed there, you will see that ages must have elapsed ere traces of man would again become visible, and that then they would be found with a greatly changed contemporary fauna, and a condition of the earth different from that which preceded it. I believe that much of the cave phenomena and of the alluvial deposits in Europe, may be attributed to the Noachian deluge, or catastrophes of the like nature that previously occurred, of which there is no tradition, and that other instances quoted are as truly antediluvian, but after the creation.

There are some remarkable facts in Sir Charles Lyell's work, in connection with deposits in which the remains of man occur associated with those of the extinct animals. 1st.—These deposits are not simple strata—limestones or other rock formations, but are made up of the erosion of such formations including the glacial drift and later accumulations, a loose incoherent mass of chalky marl, sand, gravel and clay—none of which are native of the place where they are found—but brought there by streams from a distance, and from higher grounds. 2ndly.—The remains are not in the relative positions in which we might expect to find those of man, still an inhabitant of the earth, and those of wild animals of such huge forms and assumed fierce dispositions as

were the extinct species. They are just in such proximity or association, as though the extinct monsters had held the same relation to man as the domesticated cattle of the present day—as though it were a millenial period—the teeth of a mammoth being found by the skull of a young person—another skull in a breccia in which was the tooth of a rhinoceros—another in which a perfect flint tool was in close proximity to the leg of a cave bear; and numerous other instances of fraternal position between these and other extinctions and the human race. You of course cannot believe in this harmony of nature, and therefore it is necessary to account for the position of these remains in some other way. It may puzzle you to think how it could have occurred at all, judging from any progressive changes that come under observation at the present day.

But there is another fact to which, in the third place, I beg to advert, and which seems to me to be still more strange when properly considered; but which is relied upon as the strongest evidence of the coeval existence of man with the extinct species. It is the finding of the remains of man and his tools and implements, in the *lowest* part of the *lowest strata* of sand, gravel, &c., both in the cave deposits and river alluvium. I will recite some of these instances:—

Cave Deposits:—

1. The cavern of Pondres, in which human bones occurred in the same mud with the bones of an extinct hyena and rhinoceros. The cavern was in this instance filled up to the roof with mud and gravel in which fragments of two kinds of pottery were detected—the lowest and rudest at the *bottom* of the cave, *below the level of the extinct mammalia.*

2. In the caverns of Engis and Engihoul, on the Meuse.—"Speaking generally, it may be said that human bones, where any were met with, occurred at all depths in the cave mud and gravel, sometimes above, and sometimes *below* those of the bear, elephant, rhinoceros, hyena," &c.

3. Lyell's exploration in the Engihoul cavern.—"Bones and teeth of the cave bear were *soon* found, and several other extinct quadrupeds. * * My companion continuing the work perseveringly *for weeks* after my departure, succeeded *at length* in extracting from the same deposit, at the depth of two feet *below*

the crust of stalagmite, three fragments of a human skull, and two perfect lower jaws with teeth, all *associated* in such a manner with the bones of bears, large pachyderms and ruminants, and so precisely resembling these in colour and state of preservation, as to leave no doubt in his mind that man was contemporary with the extinct animals."

4. The Neanderthal cave.—A human skeleton found near the *bottom* of loam which covered the floor of the cave, and the skull near the entrance, as though it had gone into the cave head foremost through some communication with the surface, amongst the *first* matter washed in.

5. The skull of an adult individual found in the Engis cave near Liege, associated with the elephant, rhinoceros, bear, tiger, hyena—all of extinct species, but nevertheless accompanied by a bear, stag, wolf, fox, beaver, and many other quadrupeds of species still living—a fact which has considerable bearing on this question, and which it is as well to keep in remembrance in connection therewith.

6. Caves of Gower in Glamorganshire, South Wales. — "But the discovery of most importance, as bearing on the subject of the present work, is the occurrence in a newly discovered cave, called Long Hole, by Colonel Wood, in 1861, of the remains of two species of rhinoceros, *R. tichorinus* and *R. hemitæchus* (Falconer), in an undisturbed deposit, *in the lower part of which* were some well-shaped flint knives, evidently of human workmanship. It is clear *from their position* that man was coeval with these two species. We have elsewhere independent proofs of his coexistence with every other species of the cave fauna of Glamorganshire; but this is the first well-authenticated example of the occurrence of *R. hemitæchus* in connection with human implements."

River Alluvium :—

7. M. Boucher de Perthes in the first vol. of his "*Antiquites Celtiques*," published in 1847—states that he found flint implements in the *lowest* beds of a series of ancient alluvial strata bordering the valley of the Somme,—the tools were stated to occur at various depths, often twenty or thirty feet from the surface, in sand and gravel, especially in those strata which were nearly in contact with the subjacent white chalk.

8. Dr. Rigollot, having inspected the collection of M. Boucher

de Perthes, returned home, resolved to look for himself for flint tools in the gravel pits near Amiens. There he immediately found abundance of similar flint implements, precisely the same in their make and geological position, some of them in gravel nearly on a level with the Somme, others in similar deposits *resting on chalk*, at a height of about ninety feet above the river.

I need not multiply *unconscious* instances. These are remarkable arrangements of strata. We have man resting on the chalk, or nearly so, along with river and land shells of *living* species. Then come remains of contemporary animals of species which still exist. Then are found mollusca, of species not now living in Northern Europe, and others of living species. Then the cave hyenas, bears, and lions. Then the hippopotamus, rhinoceros, *elephas antiquus E. primigenius*, &c.,—the *last* first and the *first* last. Judging from the composition of the strata, which is a mixture and mingling of all the formations from the lowest eocene to the superficial surface accumulations, we certainly might expect to find, here and there, a representative of each of the extinct mammalia. The strange fact is, that they are in reversed order, or in such a position as would imply that a reversion was going on when they were deposited. But if this order of superposition is relied upon as proof that man was coeval in time with all these extinct animals, it ought to be held equally as proof that man existed before them, seeing that his remains are often found, almost as a rule, *beneath* them. While, therefore, it is not improbable that some of the now extinct animals may have come down to his era, we get a much more intelligent glimpse of his true position and time in creation, by finding his remains more intimately associated with species which now exist, which must have been contemporary with him, although created before him.

The geological record may, however, be read in another way—by placing man at the *head* of the creations of the Tertiary period instead of at its *foot;* and then following down from the recent to the eocene, we shall have the *received* order of superposition so far as the strata of the embraced periods are concerned. Man would then be found in his proper place, the associate of all existing species, and probably of some of the extinctions, and with all living species of land and marine mollusca, and would not be found in

simple strata later than the recent, although it would not be extraordinary if his remains should be discovered in mingled strata—that upon which he was created with that upon which the extinct animals roamed and existed. This order does no violence to chronology, but rather sustains it. It makes man the last created mammal, and the cattle preceding him, and the wild beasts later still; and still preceding them extinctions of species for which the earth had become gradually unfitted. It goes further. It settles the point with reference to cave deposits and river alluviums, which are simply the mud of the erosions of surface and lower strata, burdened with the contents of each as the floods have reached them consecutively, sometimes mingled in their passage, or embedded successively at lower levels than the sites from which they had been washed. And this is the reason why we sometimes find flint implements in the lowest beds, or mingled with animal remains in the strata next imposed.

I have thus come shortly, with due reference to the time which reading this paper will occupy, to that stage of progress when exemplifications are necessary to verify the positions I have assumed. I find these, to my own satisfaction at least, in the book to which I have so frequently referred.

Sir Charles Lyell alludes to the investigations made by M. Tournal, an eminent archæologist, in 1828, in the cavern of Bize, in the department of the Aude, South of France. M. Tournal states that in this cavern he had found human bones and teeth, together *with fragments of rude pottery* in the same mud and breccia, cemented by stalagmite, *in which land shells of living species* were imbedded, and the bones of mammalia, some of extinct, *others of recent species.* The human bones were declared by his fellow labourer, M. Marcel de Serres, to be in the same chemical condition as those of the accompanying quadrupeds. Five years later M. Tournal, speaking of these fossils, states that—"they could not be referred to a diluvial catastrophe, but must have been introduced gradually, together with the enveloping sand and gravel *at successive periods.*"

If the pottery described here was in a similar position to that described by M. Christol in the cavern of Pondres, to which I have previously alluded, we may suppose the relics of man in the

cavern of Bize were *near* the bottom also, *below* the extinct mammalia, and this taken with M. Tournal's assertion that they were introduced *at successive periods*, enables me to draw the following inference in support of my views :—

We have no data to determine in what condition this part of the earth may have been at the period assigned as that of man's creation. We know of but one spot that is said to have been altogether pleasant. That previous to that event various species of animals roamed here, died, and became embedded, is exceedingly probable. Man at length came upon the scene, lived and died also. Consequently his remains and his works, with those of recent species, and those of extinctions, if some of them came down to his era, lay at the surface. Ages elapse, oscillations occur, and there are signs of approaching submergence of the land. Floods are frequent, sweeping the surface of its contents, and precipitating them into rents, communicating with systems of subterranean channels and caves. They form the undermost deposits in all such caves. Oscillations continue, *lower strata* are exposed and eroded, and bones of quadrupeds, extinct even then, are washed out, and they too are precipitated into caverns and channels, and form a superimposed secondary deposit. The grand submergence takes place—the Noachian deluge prevails in these latitudes—the quick upheaval follows, and animal relics, bones clothed with flesh, but rent and dismembered by conflicting elements, are introduced. In process of time stalactite drips through the roof, and stalagmite covers the floor of the caverns, which remain in that condition until developed by scientific research, a subject of speculation in the nineteenth century of the Christian era.

Time will not permit me to discuss this portion of the subject at much greater length. It may however be observed that there will be various modifications of cave deposits; and that although the proper place of human remains, washed from the surface and higher levels, is underneath other remains, when so found, it may have been that caverns were filled with relics long before man appeared; and in these the extinct animals and perhaps existing species may have mingled, and the remains of man, if any, washed in at a future period, would then be in the upper stratum. There ought to be no mistaking the geological age of caverns like these. It

may have been also, and the case seems proved, that bones and implements of man have been washed out from the surface, and rolled in the beds or channels of rivers or torrents; and that lower strata, in which reposed the remains of older animals being reached, that both may have been mingled and further rolled and triturated in the same streams for a long time, before communication with the interior was made—and thus these remains would be identical "in appearance, colour, and chemical condition,"—then they may have gone in a mingled mass into the cavernous passages and fissures, and would be found, as Schmerling found his deposits in the Enjis and Engihoul caverns before referred to—*at all depths*, and their respective ages undistinguishable.

I cannot discover any good reason why man and many animals now extinct, may not have existed together in the chronologic era, from the creation to the deluge. On the contrary, the evidence appears to me to favour their coexistence. That the Noachian deluge was partial or otherwise, is not now the question—that there was such an event universal tradition would inspire the conviction, even though the record were lost. Allowing then that it extended to northern regions inhabited by man, some of the caverns near the sea, those at Brixham, in Devon, for instance, in which animal bones and flint implements are found, may be referable to such a disturbance, and others to the period immediately after. There are several circumstances connected with the Brixham caves which favour this opinion. Some worn pebbles of hematite found in them, could only have come from their nearest parent rock at a period when the valleys immediately adjoining the caves were much shallower than they now are. This may have been the time of the deposition of the gravel and stones in these caves. The reddish loam in which the bones are imbedded, is such as may be seen on the surface of limestone in the neighbourhood; but the currents which were formerly charged with such mud must have run at a level 78 feet above that of the stream now flowing in the same valley—and to this time we may refer the bone deposits. It accords also with the phenomena of that event, that there is good evidence in the discovery in the mud at the bottom of the bone earth and close to the flint knives, of the entire limb of a cave bear, which must have been introduced clothed with its flesh, or with the

Relative position of the Deposits &c in the Valley of the Somme.

(See p. 93)

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bones bound together by their natural ligaments, of the co-existence of man with mammals since extinct. It further appears that the waters at first must have been propelled through these channels with great force, and thus accumulated the stony fragments—that succeeding this torrent there was a regular current, and that then fine mud and bones accumulated—and that when this stayed the stalagmite floor was gradually formed.

I might point to other instances of cavern deposits, which seem to corroborate the received chronology with reference to the age of man, which I find no valid reason for carrying back to remoter periods. I shall however rest this part of the case with the facts quoted, and proceed to examine my theory by the evidence afforded by river deposits, containing bones of extinct mammalia and flint implements similar to those of the caves.

It must be borne in mind that these alluvial deposits in valleys, are made up of erosions and denudations of the surface strata, and are similar to those which are found in caverns. We ought therefore to have the *same* phenomena—or with slight modifications—in both ; and it is so. The same inverted strata meet us here openly, which met us in the underground passages and caves communicating with the surface. In the diagram* before you, which is a section across the valley of the Somme in Picardy, you will find the regular order of superposition of strata—first the chalk (1), next the eocene strata (2), then the loam, or drift, or brick earth (3). Next you will find the upper and lower level gravels made up of denudations, which I have marked—upper (2 *a*), and lower (3 *a*); then the gravel bed (4), the peat (5), and the river Somme, as it now runs, (6). I will read the description (with these figures) from Sir Charles Lyell's book, and afterwards make a short commentary upon it, in accordance with my own views .—

"The valley of the Somme in Picardy is situated geologically in a region of white chalk with flints, the strata of which are nearly horizontal. The chalk hills which bound the valley are almost everywhere between 200 and 300 feet in height. On ascending to that elevation we find ourselves on an extensive table land, in which there are slight elevations and depressions. The white chalk itself is scarcely ever exposed at the surface on this plateau, although

* This is copied from the section in Sir Charles Lyell's book, and is not correct, but will give an idea of the position of the various deposits. (See section.)

seen on the slopes of the hills, as at *b* and *c*. The general surface of the upland region is covered continuously for miles in every direction by loam or brick earth (3) about five feet thick, devoid of fossils. To the wide extent of this loam the soil of Picardy chiefly owes its great fertility. Here and there we also observe on the chalk outlying patches of tertiary sand and clay, with eocene fossils (2), the remnants of a formation once more extensive, and which probably once spread in one continuous mass over the chalk, before the present system of valleys had begun to be shaped out. It is necessary to allude to these relics of tertiary strata, of which the larger part is missing, because their denudation has contributed largely to furnish the materials of gravels in which the flint implements and bones of extinct mammalia are entombed. From this source have been derived not only regular formed egg shaped pebbles, so common in the old fluviatile alluvium at all levels, but huge masses of sandstone several feet in diameter. The upland loam also (3) has often, in no slight degree, been formed at the expense of the same tertiary sands and clays, as is attested by its becoming more or less sandy or argillaceous, according to the nature of the nearest eocene outlier in the neighbourhood. The average width of the valley of the Somme between Amiens and Abbeville is one mile.

"It will be seen by the description given of the section, that (3 *a*) indicates the lower level gravels, and (2 *a*) the higher ones, or those rising to elevations of eighty or a hundred feet above the river. Newer than these is the peat (5), which is from ten to thirty feet in thickness, and which is not only of later date than the alluvium (3 *a*) and (2 *a*), but is also posterior to the denudation of those gravels, or to the time when the valley was excavated through them. Underneath the peat is a bed of gravel (4), from three to fourteen feet thick, which rests on undisturbed chalk. This gravel was probably formed, in part at least, when the valley was scooped out to its present depth, since which time no geological change has taken place except the growth of the peat, and certain oscillations in the general level of the country. A thin layer of impervious clay separates the gravel (4) from the peat (5), and seems to have been a necessary preliminary to the growth of the peat."

I may sum up the substance of this description in a few words. If my theory of inversion be sufficient to account for the finding of the remains of man in mixed strata—no violence will be done either to the scriptural or geological record. They will fall into their proper place in the order of creation. So also will those of the recent animals cotemporary with man: and so also will those of the extinct mammalia.

The valley of the Somme and the hills by which it is bounded, must at one time have been the bottom of a large cretaceous lake, which communicated with the sea. When the elevation of this basin into dry land occurred, the chalk arose covered continuously with a loose and incoherent eocene formation of sand and gravel containing contemporary mollusca. There is no evidence to show that this eocene strata, lying directly on the chalk, was ever inhabited, except by fresh water or land shells, up to the glacial period. As this came on and continued, there may have been great depression and submergence of the land—the loam and clay being then deposited that cover the country, much thicker than they now are, and destitute of fossils. There was a corresponding re-elevation and denudation—the surface of the country rose slowly above the reach of the water, but the configuration of the land caused a broad, deep, and rapid stream, perhaps ice laden, to run where the valley of the Somme now is, sweeping away what remained there of the superficial deposit, eroding the eocene strata, excavating the valley down to the chalk, and also eroding its sides. This stream, as oscillations occurred, may have run at a higher or lower level, but remained for a long time at the upper level (2 *a*) where its eddies accumulated the upper level gravels, which extended on either side the valley towards its centre. The higher dry land would have been overspread with herbage, and have nourished and sustained living creatures—*elephas primigenius*, *rhinoceros tichorinus*, *equus fossilis*, and other extinctions which then had roamed from more southern latitudes subsequent to the glacial era, and their remains became embedded. Long previous to the time of man's appearance on this scene, and before his creation, some of these races became extinct.

At length man in his continued migration, from the cradle of the human race, arrived at and roamed over the country, as wild as civilized man found the aborigines of this continent—wearing the skins of beasts—using stone implements and flint weapons, and possessed of the useful art of making rude pottery. He too peopled the country for ages—hunted, and lived and died there. Suppose now that the Noachian deluge affected these latitudes—that another great depression took place, and all the high hills were quietly covered by the waters—and shortly afterwards a corresponding re-

elevation. What then would have been the effect upon the surface deposits of the lands bounding the valley of the Somme? The broad waters would have been charged, first, with the uppermost stratum, the remains of man and his works, and those of contemporary fauna. Secondly, with remains of other and older mammalia—all which would have been deposited in their order on the chalky shelf (2 *a*) in the eddies of the swift stream that ran at that height, and have formed part of the alluvium (2 *a*) mingled with eocene strata (2) and extending into the valley. Thirdly, with part of the remaining unfossiliferous loam and drift which cap these gravels. As the waters decreased, the stream, cutting through (2 *a*) would have swept it nearly all away, depositing its sediment charged with its material and other debris, at (3 *a*), which would then have been the bottom of the valley, and in its turn would have succumbed to the still decreasing downward impetuous flood; and all the finer particles having now disappeared, would have left the rough gravel (4) resting upon the chalk—the newest deposit except the peat, of the valley of the Somme—and then the waters having subsided the river would have formed its present channel or something very like it, and the peat would have begun to grow.

This is my comment upon the geological deposits of the valley of the Somme. If just, it rescues them from the long past ages to which Sir Charles Lyell and other geologists have consigned man and his works, and so far as these last are concerned, brings them down to a period between the creation and the Noachian deluge. It does not, however, necessarily implicate this last event as the sole agent by which these deposits were made, for oscillations of the land and changes of level in this region, may have caused inundations which would have produced the same results. But it does show that the antiquity of man, judged by the received chronology, need no longer be a subject of dispute, or doubt, especially by the believers of Divine revelation.

The generations immediately after the Noachian deluge, buried their dead out of their sight. We have a record of this in the life of Abraham, who purchased the cave and the field of Machpelah from Ephron the Hittite, the children of Heth being witnesses; and such burial places were held sacred, sometimes visited by survivors, and occasionally opened to admit another tenant to the narrow

house. We do not for a moment suppose that Abraham originated this custom—but it may have been an *antediluvian* one,—and we therefore have a warranty to search for an antediluvian cave or grotto set apart for the sacred rite of burial. Sir Charles Lyell has found one, which he says "seems clearly to have been a sepulchral vault of the *post-pliocene!* period," near Aurignac, not far from the foot of the Pyrenees, thus carrying back its age tens of thousands of years probably before the assumed period of man's creation.

It is a grotto in the side of the hill of Fajoles, near the town of Aurignac, in the department of the Haute-Garonne, near a spur of the Pyrenees. The discovery was made by a workman (Bonnemaison), who observed that rabbits when chased ran to this spot to burrow. On reaching into the hole, he laid hold of, and drew out, much to his surprise, one of the long bones of a human skeleton. Digging into the talus he came to a large stone slab, which formed the closure of a grotto, the inside of which was almost filled with bones, among which were two human skulls. He communicated the circumstance to M. Amiel, the mayor of Aurignac, and the discovery made a great sensation. The bones were all re-interred in the parish cemetery, but not before M. Amiel, who was a medical man, and had a knowledge of anatomy, ascertained that they must have formed part of seventeen skeletons of both sexes and all ages, some so young that the ossification of the bones was incomplete. He also remarked that they must have been a race of small stature. Unfortunately the skulls were injured in the transfer, and after the lapse of eight years, when M. Lartet visited Aurignac, and a further investigation was about to be made, the sexton was unable to tell where the remains had been buried, and they have not been re-discovered to this day.

Outside this cave, among ashes and some overlying earthy layers, separating the ashes from the talus, were a great variety of bones and implements—a stone of a circular form flattened on two sides, arrows without barbs, other tools made of reindeers' horns, and a bodkin formed out of the more compact horn of a roe deer. Among the cinders outside the vault were fragments of fissile sandstone reddened by heat, which were observed to rest on a level surface of nummulitic limestone, and to have formed a hearth. There

were no human bones on the outside of the grotto, and of the various species of animals there were extinct and living species—among the former—ursus spelæus, felis spelæa, and hyena spelæa, *carnivora*,—elephas primigenius, rhinoceros tichorinus, megaceros Hibernicus, *herbivora;* and of the latter—badger, polecat, wildcat, wolf, and fox, *carnivora*,—and the pig, stag, roebuck, reindeer, and aurochs, *herbivora.*

This is a short summary of the history of the Aurignac relics. It is, to say the least, a singular instance of human remains, not enveloped in a preserving matrix, remaining for *so long* a period undecomposed. If we give them the age assumed for them by Sir Charles Lyell, they may have lain there hundreds of thousands of years, a long time for traditions or customs of burial to have been retained which descended to Abraham. But if we allow that the extinct mammalia may have peopled this region between the creation and the deluge, the fact of cave burial and the post-diluvian custom or tradition will be much more intelligible. The fossilization of the young bones in process of growth, is another marvel. And almost equally so, after the sensation excited by the discovery, is the total oblivion that fell upon the Aurignac sexton, of the spot where the remains were re-interred.

The only good reason I can discover for attributing so great an age to these human remains, is their association with those of many extinct animals, which are known to have existed and roamed the earth long ages previous to the period assigned for the creation of man. If, however, these extinctions came down to the date of the Adamic chronology, and I believe that most of them did so, equally with those which are still living species, this reason would not apply—for we might expect to find them here, the natural enemies and the food of man. We might then suppose this cave to be a burial place of some small emigrant tribe of antediluvians, who in a few generations after the first man, had found their way to this region from the centre of the race, and had hunted, and lived and feasted upon the animals of the chase, such as the remains are described to be. Against this supposition is the stated fact, that *no change* in the physical configuration of the district, such as a flood would have made, has taken place since the grotto was a place of sepulture. But if the Noachian deluge were a partial one,

which is a tenet of the modern school of philosophy, if they admit it at all, a good deal may be made out of Sir Charles Lyell's own argument in support of this theory of the age of the remains in the Aurignac grotto. Thus he says—"It is the normal state of the earth's surface to be undergoing great alterations in one place, while other areas, often in close proximity, remain for ages without any modification. In one region, rivers are deepening and widening their channels, or the waves of the sea are undermining cliffs, or the land is sinking beneath or rising above the waters, century after century, or the volcano is pouring forth torrents of lava, or showers of ashes; while in tracts *hard by*, the ancient forest, or extensive heath, or the splendid city, continue scatheless and motionless." There may then have been elevations here, and depressions at no great distance. The floods which covered the face of the country in other parts, and filled caves with the bones of men, and animals now extinct, whether Noachian, or a consequence of them, or otherwise, may have spared the region in which the Aurignac grotto is situated, while they fulfilled their mission upon the fauna at a distance, nigh or afar. The Aurignac grotto, therefore, while it shows that man may have existed with animals now extinct, affords no proof that he was as old in time as they; or even that all the monstrous existences that peopled the world at his advent, became extinct at the great catastrophe which preserved a large proportion of the species that now remain.

Our own country affords some remarkable instances of the presence of man and his works on the scene, long previous to its discovery by Europeans, and the introduction of civilization and refinement. It is easily ascertained at the present day, that the aboriginal race in this part of the continent, lived by hunting and fishing, and used stone and bone weapons of offence and defence, and implements of industry or domestic economy, precisely similar in form and fashion to those that stretch beyond the historic period in Europe. There has been no intervening bronze age in this part of the American continent. The remains and relics are the veritable weapons, utensils and pottery, in type and material, as were used by the remotest Gaul, Briton, and Scandinavian, long before a bronze implement was introduced among them. We are thus pointed to an interesting fact. That the ancient people of Europe had become

isolated from the centre of civilization, and had lost all tradition of it, except of one event; and were to it as unknown as was America, (to which the human family had also gradually spread), until the days of Columbus. The wonderful tales of the heathen mythology may therefore be no longer myths when taken in connection with the subject of the antiquity of man, and the discovery, in the north of Europe, of a new country and a strange people, and the reclamation of their millions to a state of half civilization, and an exchange of stone for the more useful and ornamental bronze and gold and silver. The time is too far distant to enable us to judge correctly whether the intruders supplanted, as on this continent they are gradually doing, or amalgamated with, the aboriginal race. The Fin, the Lap, and the Esquimaux, in the extreme north, in their lineaments and stature, their customs and usages, seem to favour the idea of a people retreating beyond the influence of manners and modes of life which they could not appreciate, and were powerless to withstand; and the ancient painted Briton, clothed in the skins of beasts, with his fishing corracle, so like the Indian, contrasted with the war chariots and splendour of his chiefs, and the power of the Druidical priesthood, leads us to believe that the advent of a superior race was attended with consequences to the aborigines of the old world, very similar to those which have been produced in the new. That advent was certainly post-diluvian, although no authentic record remains that can be depended on, of the settlement or conquest by which it was made.

One great cause of scepticism is the readiness with which mankind yield their belief to theories put forth with show of reason, by those whom they regard as superior intelligences, and in whom they repose implicit confidence. Let a man do some great thing which will bear the test of enquiry in every possible shape, and become famous thereby, and he may afterwards commit a thousand vagaries, and find multitudes to uphold him. A Lyell, a Darwin, or a Huxley, may go a long way in the path of human knowledge, make important discoveries, and satisfy the world that all they do is right and just and proper—and that therefore their theories, equally with their facts, may be received with faith equal to that which should follow plain demonstration. But there is no reason why we should respect their speculations as we do

their truths, seeing that, although in their own hands, they lead to nothing, and are nothing. Such an impotent conclusion has met Lyell, who expects to find remains of man in the submerged forest at Cromer, where they are not to be found. Such also has met Darwin, who has let go his belief in creation, and adopts variation of species instead; and such also meets Huxley, who traces back organized being to molecules, so much alike in every species, that all his philosophy cannot distinguish one from another, and who is yet compelled to acknowledge that the molecule of a horse produces a horse, that of a bear a bear, that of a camel a camel, and that of a man—although exactly like the others—a man. We must, therefore, be careful while giving due credit for the truths that such men teach, not to be led away by speculation which is not truth, and to which the test of truth cannot be applied with any satisfactory results.

But it is time that I should bring these observations to a close. We are all searching after truth—whether we look to find it in the past, of the beginning and progress of which we know so little, and which seems to our finite capacities an eternity of duration,—or in the present, in which we have an interest for three score years and ten, to mould it for the future,—or forward to that future, whose duration will be infinite, and in which we expect to be partakers of another form of existence that shall not change. We glean here and there, with the depths of the wisdom so dearly purchased for us by the first man with the penalty of a short life, a few startling facts, which create in us wonder and awe at the stupendous work of creation. We reason upon them with the aid of science, and make a little progress in unravelling their history, and are then brought to a stand still, or are lost in endless and unprofitable speculation. Looking backward or forward, and investigating as we may, we find no theory so stable as the recorded order of creation—none with which our geological facts so well agree;—and as this has not been written in detail, and therefore not so much for our learning as the exercise of our faith and for our edification, we may rest assured that our faculties are given us, less on account of what has been done, than for what there is to do; and that the exploration of the earth for the past history of man is of little consequence as it concerns his present happiness,

to say nothing of the future, while it only tends to perplex his ideas and unsettle his reason. Taking this view of the subject I am quite content in my belief that man was the last mammal created. That he had his time and place assigned to him in that sublime expression of the Will of the Almighty Creator, with whom to will is to execute, Who said—"Let us make man in Our image, after Our likeness—and let them have dominion over the fish of the sea—and over the fowl of the air—and over the cattle—and over all the earth—and over every creeping thing that creepeth upon the earth."

Art. X. Notes on the Weather at Halifax, Nova Scotia, during 1864. By Colonel Myers.

[*Read Monday Evening, April* 6, 1865.]

The year 1864 began with a gale of wind from S. E., and snow, which latter, however, soon turned to rain. The remainder of the month of January was generally fine, and, with the exception of two days, when the mercury stood a few degrees below zero, the weather was mild for the season. The mean temperature was 23°, being 7° lower than it was in 1863.

The weather in February was unsettled; the mean temperature 26°, being 3° higher than in 1863.

March was stormy and unsettled; mean temperature 28°, being 3° higher than 1863,

April weather variable, with high winds; mean temperature 36°, being 2° lower than in 1863.

May generally fine, though fogs were frequent; mean temperature 48°, being 10° higher than 1863.

June fine, but season backward, in consequence of the want of rain and prevalence of cold sea fogs; mean temperature 57°, being 3° higher than in 1863.

July very fine and dry; mean temperature 62°, being 3° lower than 1863.

August, though generally fine was characterized by occasional heavy rains; mean temperature 64°, being exactly the same as last year.

September very fine, with the exception of a few days of heavy rain; mean temperature 56°, being 2° lower than 1863.

October for the most part lowering and rainy. Frosts occurred towards the end of the month; mean temperature 46°, being 5°, lower than 1863.

November generally unsettled; mean temperature 39°, being 1° lower than in 1863.

December weather variable and stormy; mean temperature 27°, being 1° higher than in 1863. The year closed with some severe weather.

The highest temperature in the shade recorded by me during 1864, was 92°, on the 15th June; the lowest—5° during the nights of 23rd and 24th of December. The highest monthly range, 55°, in June; the lowest 33°, in July and September.

Yearly range 97°; the hottest month was August; the coldest January; the mean temperature of the year was 43°, being 1° lower than that of 1863.

The highest reading of the barometer was 30°.26 on the 10th December; the lowest, 28°.48 on 22nd December. The highest monthly range, 1°.78 in December; the lowest, .54 in July. Yearly range, 1°.78. The mean for the year, 29°.65.

The most prevalent winds during the year were N.W. and S.W. The least prevalent S. and E.

Rain fell on 118 days; snow on 49; hail on 8; and fog was present on 56 days.

Aurora Boreales were visible on 54 nights; there were 16 solar, and 17 lunar halos.

Thunder storms occurred on 12th March at 8 o'clock, A. M., and at 1 o'clock, P. M.; on 31st May; 27th June, and 12th July; on the 2nd, 11th, and 26th August; on 12th and 13th September, and on 14th and 17th October. Lightning was seen, but thunder not heard, on 3rd and 12th July; on 25th September, and on 8th October. Thunder was heard, but lightning not seen, on 13th, 20th, and 23rd June.

The latest fall of snow in the Spring was on the 20th April, and in the Autumn a few flakes were observed as early as the 20th October. Fine weather predominated during the year, and the summer was remarkable for its dryness. In some places the want of rain was much felt, and, even in our abundantly supplied city, apprehensions were entertained of a failure of water, the lakes

having fallen below their usual level. There were but few heavy gales, and I may here mention that the late Judge STEWART favored me with a communication, only a few months before his death, in which he stated that he had frequently noticed that storms, which from time to time prevailed in the northern parts of this continent, extending as far south as New York, and approaching as near as Truro and Windsor in this Province, did not reach Halifax, where, while New York, Boston, St. John, and the circumjacent country were devastated, calm and fine weather prevailed. The Judge had hence assumed the hypothesis that Halifax is the centre of a storm circle, and he thought, if the attention of the government were called to the subject by this Institute, it might be induced to regard it as worthy of notice, and grant a small sum annually to be expended in obtaining from the telegraph company such daily information as would enable us to ascertain whether this view is a correct one; which, if established, would be of some importance to disabuse the world of the idea, so universally entertained, that this is pre-eminently the land of fog and storms. If an interchange of weather signals between the Smithsonian Institute at Washington and Halifax, which is now under consideration, can be accomplished, it will do much in furtherance of this object, and should the assistance of the government be required in carrying out any arrangement of this kind, it will no doubt be freely accorded.

Among several fine displays of aurora borealis, for which the past year was distinguished, one, on the night of 7th—8th of June, surpassed in magnificent beauty, extensive diffusion, and length of duration, anything of the kind I had ever before witnessed. At eight o'clock, P. M., of the 7th, a violent squall of wind from the N. W., with heavy rain, passed over the city, after which the weather became calm and cloudless. At about nine o'clock bright undulating sheets of light were first observed in the whole northern part of the sky, extending upwards beyond the zenith, and, by degrees, overspreading the heavens in the form of an immense tent, making the night as light as day. At midnight its appearance was peculiarly beautiful. Iridescent rays, darting rapidly upwards from the north, mingled together beneath the apex of this vast canopy, forming large luminous masses, which, with a rolling motion, at one time gradually faded away, only shortly to re-appear with additional

splendour. Thus it continued until about one, A. M., of the 8th, when the whole began to subside towards the north, forming an arch, which extended from east to west about fifteen degrees above the northern horizon. The arch was depressed at the centre, and luminous streamers occasionally shot up from it, till it entirely disappeared soon afterwards. The weather of the preceding week had been calm and fair, with the exception of the squall on the same evening, and two days on which there had been rain and fog. The atmospheric pressure was 29°.73; the temperature 45°. Two days afterwards stormy southerly weather prevailed, which I have often observed to follow the appearance of Aurora Borealis. I have been led to notice this phenomenon more particularly from having read in the Proceedings of the British Meteorological Society of November, 1864, an interesting description, by F. Abbott, Esq., of a rich and rare Aurora Australis he had observed at Hobart Town, on the evening of the 8th June, 1864. The occurrence of two such unusual appearances, at nearly the same time, in the northern and southern hemispheres, and their resemblance to each other in some of their features, struck me as being very remarkable.

On the 22nd of April a fine Parhelion was visible between five and six o'clock, P. M.

At midnight, 24th June, a bright stream of light was observed to rise vertically from the eastern horizon, gradually spreading out in its progress upwards, like the vast tail of a comet; a similar appearance occurred on the 27th September, at 7 P. M.

The following periodic phenomena will not probably be uninteresting:—

January—16th, smelts taken in Porter's Lake full of spawn.

February—7th, black and white birch bear catkins owing to the very mild weather; red maple and currant bushes in bud; 8th, moose bush buds bursting into leaf.

March—3rd, migratory thrush seen; 5th, a silver thaw; 8th, gnats and small flies appear in houses; 10th, blue jays seen; 11th, wild geese going north, and pine grosbeak about; 21st, migratory thrushes in fields; 31st, Mayflower plucked near North West Arm.

April—1st, song sparrow and blue bird seen; 2nd, white throated sparrow first heard; 5th, North West Arm frozen over

again slightly, after having been free of ice for some days; 7th, water spider on brooks; 22nd, "Camberwell beauty" butterfly flying about; gnats dancing in the air; swallows first seen; migratory thrush sings; 24th, hermit thrush first seen; 25th, frogs heard; meadows getting green, and rhubarb sprouting; 26th, poplar (*P. tremuloides*) in blossom; 30th, frog spawn in ponds; pine in new leaf.

May—2nd, red maple buds in forward state; 3rd, birch and hacmatac in bud; blue violet in blossom; 4th, brown snake first seen; 5th, wild gooseberry in leaf; 6th, gray hunting spider on stone walls; 22nd, frost occurred; 29th, apple trees in full leaf; blueberry in blossom.

June—4th, clouded yellow butterfly about; 5th, birch and red maple in full leaf; balsam poplar in leaf; dandelion in seed; 6th, pigeon-berry in blossom; buttercup in flower; 8th, Bermudiana in blossom; 9th, ash in young leaf; 11th, red spruce in flower; apple in blossom; large tiger swallow-tail butterfly about; 12th, ground juniper in flower; withrod flowers just forming; 13th, timothy grass in flower; 14th, yellow potentella in blossom; 17th, lilac in full bloom; 18th, white weed in full bloom; 19th, ash in blossom; 21st, firefly first seen; 29th, ash in full leaf; lilac blossoms fading.

July—6th, blackberry in full bloom; withrod in blossom; 9th, timothy grass ripe; 10th, white acacia in bloom; 15th, strawberries abundant; wild rose in blossom; gad-fly abound and troublesome to cattle; 19th, brooks and watercourses dried up; cattle suffer for want of rain; 25th, cracking locust first heard; 30th, black and red spruce bear cones in abundance. During this and the succeeding month vast quantities of *medusæ* were observed floating about the harbour.

August—7th, blueberries abundant; 21st, red maple leaves turning crimson in wet places; 28th, golden rod in flower.

September—5th, Michaelmas daisy in full bloom; 9th, field cricket sings in pastures; 21st, mackerel abundant in the harbour; 22nd, maples, birch, and poplar turning colour rapidly in the forests; 23rd, blueberry leaves changing colour; pigeon-berry still in flower.

October—2nd, pine sheds its leaves; 7th, grasshoppers still about.

December—2nd, snow bunting first seen on the common; 10th, witch hazel in blossom.

By the kindness of Judge Wilkins I have had an opportunity of inspecting a register, in his possession, of observations, regularly noted three times a day, of the temperature at Halifax during the months of December and January in three successive years, from December 1809 to January 1812. With the assistance of this interesting document, I have been enabled to compare the mean temperature of these winter months, upwards of fifty years ago, with that of the same months in 1863, 1864, and 1865, and the result is as follows:—

Date.	Mean temp.	Date.	Mean temp.	Date.	Mean temp.
Dec. 1809	33°	1810	27°	1811	36°
		1863	26°	1864	27°
Jany. 1810	21°	1811	27°	1812	25°
" 1863	30°	1864	23°	1865	22°

This tends rather to invalidate the supposition, so generally admitted, that the winters of the present time are milder than those of former years: but it would be premature to form a decided opinion upon this point without a more extended investigation, the means for pursuing which may possibly yet be found.

Art. XI. On the Gaspereaux. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

[*Read April* 6, 1865.]

Alosa Tyrannus { Gasperot (Mons. Deny, 1675,) Gaspereau.
Spring herring.....Blue back.
Alewife.....Kiack.

Should any one on a warm evening of the last of April or beginning of May, stand at the mouth of any of our rocky streams, pouring their snow-swollen torrents down to join the sea, he may see, as the last of the flood tide sweeps up to meet their turbulent waters, on every jutting point, on every isolated rock, a figure with a bag net on the end of a ten or fifteen foot pole, casting his net again and again, into every little pool or whirling eddy at his feet, and returning it as often filled with one, two, or more glittering fish,

which with a dexterous toss he throws upon a silvery heap, tossing and flapping their lives away on the warm grass hard by. The warm setting sun is throwing his beams, athwart rock and tree, and little fires lighted to drive away the black flies, are wreathing the tree boles with scanty smoke. As we pass figure after figure we find them mostly young men or boys, negroes, here and there an old settler with a known love for sport, and at the day which we write of, numerous Indians. The game is not enough to lure the strong man from his farm or his mill; he leaves it for his boys and his poorer neighbours. We pass the rogue who stole our last year's best bough apples; we pass Peter Prince's ragged, and white-teethed progeny, but pause, attracted, as we all are, by the man of the forest, the man of no house, or no key to his front door. He stands before us casting back-handed throws of his bag-net, with true Asiatic grace, so different from the direct Anglo-Saxon plunge of his neighbours, so resembling round hand bowling, the last nobby dodge of the cricketer. In the days of which we speak, he stood bare head and neck, a scarlet-seamed blue hunting frock girt about his loins by a gay girdle, holding his knife and tobacco pouch, scarlet edged leggings shewed fairly his clean curved limbs, and mocassins of his own make covered his firm foot. "Brother," we say, "is the sport good?" "Too much water, all get up before the lakes fall;" and as he speaks he lands two or three glittering fish at our feet. As they roll and toss on the warm grass, their large lidless eyes filled with dust, the sun for the first time glinting their sides of molten silver, we handle and examine them. Fresh from the cool water they are covered with slime; the scales readily come off in our hands. When the scales are entire their colour is silvery from the belly nearly to the back; along the back there runs a dusky greenish line, a thousand reflections of green and violet break the surface; the head and cheeks have a yellowish tinge with a little violet; the fins so lately waving in water transparent are already darkening and stiffening. As in his restless struggles the scales come off, we find the colours of his back deepening, and a black spot showing near his gills. His description in our notes reads:—

Length from 10 to 12½ inches, colour, when fresh from the water and covered with scales, silvery, greenish dusky on back and about an inch

down the side, green and violet reflections casting everywhere; opercles yellowish with violet reflections; about ten or less faint bands, by turning the fish to the light may be observed, passing longitudinally from gills to tail; a black spot immediately behind the opercle, lips dusky, fins yellowish or greenish dusky, the points, and first rays darker than the others; the same colour in the caudal fins. The scales are so deciduous that they fall off in handling; and then we find the colour of the back more decided, the longitudinal bands showing as rows of distinct spots, and the black spot behind the opercle very distinct. In general appearance the fish is rounder and shorter than the herring—greatest width anterior to dorsal fin—and about one fifth the length, eye half an inch in diameter, irides silvery, a little more than its diameter from tip of upper lip, lip notched to receive the lower lip in; nostrils open half way between tip of nose, and eye; the head shorter and smaller than the herring; the belly strongly serrated, about 35 points from gill-ray to anus.

Fins—dorsal fin, 15 rays, the first very short, and joining the second which is the highest—irregularly rhomboidal, pectoral 16 rays, second and third the longest, ventral 9, anal 17; caudal deeply cleft almost to the scales, having two half rays, then seven entire rays, then several more half rays, then seven entire ones and ending with two short ones, the caudal fin often split and fringed, the gill ray seven of a side, the last one square pointed—no teeth.

D. 15, P. 16. V. 9, A. 17, C. 14 entire, 8 or 10 half rays.

Our specimen is now dead, and we note how fleeting the colours of the fins are, which almost should be described when floating in water, and covered as the whole body is with nacre, doubtless to keep the water from penetrating the joints of the scales. We are now aware that our fish is a true *alosa*, allied to the shad, the menhaden, and many others, and that the stream before us is crowded with a multitudinous marine army, coming up with the last of the flood, and running the rivers to reach the lakes to spawn. A little further up the stream, the river becomes deep and smooth, and is crossed by the high road. Lying at our length on the log bridge, we watch a continuous stream passing slowly up and up, two or three inches apart. Farther up, and the river breaks over a smooth plane of slate stones too shallow for his depth. Arrived at this plane, he throws himself as far up as he can, and then commences a series of spasmodic flaps with his tail.

Slowly and painfully he passes over and drops exhausted into the tranquil pool above. Utterly exhausted, they lie heads and tails in a confused mass. Presently recruiting, their heads all pointing up stream, they again commence their march.

In countless hordes they sweep through lonely still waters, the home of the trout, cool and pellucid enough to tempt a weary way wanderer, but on and on his irresistible instinct drives him. A natural dam, some two or three feet elevation, and over which the waters fall with a perpendicular rush, now arrests his progress. He throws himself (no doubt with a vigorous sweep of tail) directly at it. That about two and a half to three feet is his utmost range, the many failures he makes before he drops into the pool above attest.

He has now gained his lake, often a very small one in the heart of the forest, and perhaps six hundred feet elevation from high water mark. And now commences his brief courtship, for, unlike the lordly salmon who dallies until November, our fish has but little time for delay. Camping on the lake-side of a moonlight night, you hear a swash in the water. "What fish is that?" you ask your Indian; "Gaspereaux," is his answer. The trout-fisher by day sees the surface of the lake ruffled by a hundred fins, then the trout break all around him. "See the Gaspereaux hunting the trout," he says. But these are only his harmless gambols, coloured by the resistless instinct of reproduction. He has even been known to rise at a fly, and to take a bait on these waters. Although the salmon and trout are often seen spawning, I never met any one who has seen the Gaspereaux in the act. So I suppose he spawns in deep water, as we know he loves the deep lakes with clear sandy margins.

As hatching is a much shorter process than with the salmonidæ, there seems to be less need of a current of aerated water constantly floating over the eggs, and thus the deep still waters of the lake may be chosen. No doubt the moment spawning is over, his instinct teaches him to return to salt water; but there seems some difficulty in determining the exact time. This must be measured by the power of either parent fish to retain the spawn within their bodies. Some observers put it at twenty-one days, in which time, from leaving the sea, the Gaspereaux has spawned and commenced his return, allowing that he has met with no obstruction. On the other hand, sportsmen assure me that they have met them during July on the lakes, and others, whose powers of observation I cannot doubt, have seen them passing down in August. But they all

agree that the young fry go down into the sea in September and October, at which time they are over four inches in length. Messrs. Treat & Sons' gaspereaux spawned about the first of June. The date of placing them in fresh water is not given, but as they would scarcely have been obtained before the first of May, it gives them three weeks for their spawning period.*

From all these we learn that in three or four weeks after leaving the salt water, his brief holiday over, our fish commences his return. Unnerved by the exhausting toil of reproduction, by the absence of food (their stomachs are found empty on the lakes), and perchance by the warming summer waters, he addresses himself to the perils and dangers of descent. Too poor for an object of capture, he slips down unnoticed, save by the idle or curious, where, a few weeks before, a whole population watched his ascent. It is said those marine wolves, the eels, follow the advancing and retreating armies in their rear, gobbling up many a weak fish, or unlucky little one on the march. A dry summer has emptied the lakes and turned the foaming torrents of the spring into dusty rills. He often gets caught in these lukewarm shallows and dies. Not unfrequently the hunter finds them in bushels in the fords; quite as often the bear secures a rich feast—dipping his hairy paws into the shallow pools. He may be seen approaching nervously and timidly a rapid, then striking up stream, and returning pass down tail first. Those which are seen in July, or passing down in August, we must consider fish that have left the sea late in May, or that are caught by

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* Messrs. U. S. Treat & Sons, of Eastport, Maine, placed Gaspereaux in fresh water ponds during the spring of 1857; on the first of June they spawned, in six weeks the eggs were hatched, in four months they were let down to the sea from three to five inches in length.—*Patent Office Report*, 1857, *page* 230.

A gentleman who allows me to use his experience, but not his name, and who is entitled by his position and practical knowledge to the highest consideration says, "My observation has led me to note that the gaspereaux having free access to their spawning grounds, remain exactly twenty-one days in fresh water, and during the twenty-four hours, only journey downwards to the salt water between the hours of three and five P. M. The fry of gaspereaux leave the lake in which they spawned on the dark nights of September, together with the eels. Any one can notice this that choses to watch an eel weir placed upon a stream. When gaspereaux are heard and seen at night breaking the water about the sandy margins of a lake, in my opinion they are spawning and act in a precisely like manner to salt water herring when they seek shoal-water in salt water for that purpose. I have never observed a gaspereau to rise at a fly; but I know of many instances of their being hooked by fishermen, but it was what I call a foul hook—the angler having thrown over them when the school arose to the surface of the water. The instances that I have witnessed have invariably taken place when a multitude of gaspereaux have been detained on their ascent by a dam."

the dry season, and go down during the August freshets. Finally, October seems to be the last date for even the fry to be seen in fresh water.

We have thus received the Gaspereaux from the moment he left salt water, conducted him through all his perils, and had him as it were under our eye till we have returned him to deep water again, three months out of the twelve. The other nine months he is hid from us. They are taken in small numbers, generally with herring, sometimes with the mackerel, as late as 24th November, on our coast, but they are evidently only stragglers, the great body that swarmed our rivers must leave our coast, to return in spring. They return either to deep soundings or to the south. And now a change takes place in the colour of a few individuals, that is, so far, unaccountable to us. After gaining the salt water the lean weak fish rapidly recruits, becomes silvery, very fat, and a few individuals have a deep blue band of one inch and a quarter extending along the back. In all other respects—of fins and fin rays—they are identical with the rest. Our fishermen call them blue-backs, readily distinguish them, and maintain them to be a separate fish. Whilst differing from them, I must accord my obligation to their intelligence and exact appreciation of minute differences, in the form and habits of fish. On the 15th November, 1864, Martin Harrigan gave me two blue-backs; 27th November, two more specimens.

Colour.—Very brilliant; silvery, with deep blue backs extending one inch and a quarter down the side. Covered with nacre, and scales entire, the longitudinal bands extending from gills to tail difficult to see,—the black spot behind the opercle showing,—by turning them in various lights they become apparent; the colour of all the fins yellowish white; the extremities dusky, in pectoral first ray dusky; the caudal light-dusky, frayed and split on its extremities; opercles yellowish, with reflections, and lips yellowish-dusky. In comparing them with a gaspereaux taken at the same date, I find fins, fin-rays identical; the blue-back is rather shorter, but much rounder and thicker through the sides, the scales appearing larger.

A gaspereau seen at this late date being very thin, "slinky" as the fishermen call it, his scales loose, and his colour yellowish silvery, and green dusky on the back. A very fat fish swells out the scales, making them larger; as he thins they slide in upon each other. Whilst concluding that they are of one species, I still think that the salt water is the cause of the change; but why it only

affects individuals is still unknown. Blue-backs are often seen ascending the rivers, but I have no evidence of any being found descending them. Their more valuable congener, the shad,* is subject to the same change.

Of the food of gaspereaux, one would suppose from the toothless jaws and wide extensive gape, so unlike the recurved teeth and armed tongue of the genus salmo, evidently formed for seizing living and struggling food, that he was fed by gelatinous masses sucked into a wide mouth. Of his rising to a fly, and taking bait in the lakes, we have proof, and Dekay asserts, the stomach of one he examined was filled with shrimps. Dekay's descriptions refer to a smaller and longer proportioned fish than ours, with the eye further from the end of nose, but otherwise it tallies with ours, and his plate is good. From him, too, we learn that its southern range is the Chesapeake, where he appears in April. From Perley we find his northern range, Miramichi, which river he ascends to spawn in the lakes from which it has its source. Though doubtless it was known from the earliest discoveries of the province,† yet Latrobe, in the Philosophical Transactions of America, was the first to describe it, and give it the specific name, "*tyrannus*," preceding Peck, who calls it "*serratus*," in Belknap's History of New Hampshire, I have not the exact date to refer to, but somewhere about 1780. As an article of food, when eaten fresh, it is not held in great estimation in our markets. When slightly struck with salt and smoke-dried it is called a "Kiack," and is very palatable. Many are cured in this way about Lunenburg and the Atlantic seaboard. The Indians dry them in the sun about their wigwams, but the usual way is to salt them in barrels like herring, and use them in each family for home consumption. Their leanness makes them a good export for the West Indies, as the fat herring becomes completely decomposed into oil by the climate. As is the case with all fish which perform annual migrations to spawn in fresh water, they gradually desert cultivated countries. The various obstructions to

* The Rev. Ferdinand Gauvreau, P. P., Memremcook, N. B., says of the shad, "the first run are green on the back, the second a pale green, and the third run have blue backs, and are the best fish."—*Perley's Report, p.* 144.

† Beamish Murdoch, Esq., was kind enough to point out to me, in Mons. Deny's History of Acady, 1675, the word "Gasperot." This gentleman, who describes what he saw with the liveliness of an eye witness, says of them truly enough, "they are not equal to the herring for eating."

the streams, caused by mill-dams, and accumulations of saw dust, and the passing of boats, are doubtless the reason. Their numbers have very much diminished along our coast, and doubtless will continue so to do. By the government returns for 1861, the total number cured is put down at 12,565 barrels, but this does not include all used for family consumption,—the eastern portion of the province giving by far the greater quantity. Since that date they are not returned separately, but classed with herring. I have not mentioned one power attributed to it, because I think it needs further corroboration,—the power of climbing up perpendicular heights, as mill-dams, by holding on by its sharp serrated belly. The instinct of all fish is to lie flat in shallow places; the climbing fish having a different apparatus. However, I mention it as a very common belief. I would rather hazard the suggestion that their saw points are used in spawning, as the trout uses his lower jaw, in furrowing up the sand.

Note.—Since this article went to press, I have the most undoubted authority that trout possess the power of running up perpendicular sheets of water at least six feet high, and I cannot but accord the same power to the gaspereaux; in both instances by muscular action, and not by the serrated belly. On 2nd August, 1865, the mill dam at nine mile river was filled by young and old gaspereaux, returning to the sea, caught there by the dry summer. Lewis Kirby, Esq. gave me this fact.

In both these facts, I feel pleased to corroborate the statements of our fishermen, which I have always found correct and exact, though doubted by some.

Art. XII. Contributions to the Natural History of Nova Scotia. Reptilia. By J. M. Jones, F. L. S.

(*Read May* 2, 1865.)

The class Reptilia forms no unimportant part of the animal kingdom, and in the present advanced state of zoological knowledge the species known to naturalists are annually becoming more numerous. In the early days of science, when natural history had few students, and even down to a comparatively recent period, the study of reptiles was almost totally neglected; and in the museums of divers countries a few stray bottles full of snakes and lizards, unnamed and uncared for, lying in some obscure corner, and deemed too disgusting for the eyes of visiters, were the only representatives of this singular race of creatures. It is far different, however, now, for in our splendid national museum we possess a collection which for interest can hardly be surpassed by other zoological

departments, while, both in Europe and America, the study of Herpetology has become a prominent branch of scientific research.

In taking a survey of the geographical distribution of reptiles over the surface of the globe, we at once perceive that under the influence of the greatest continued heat they appear to thrive in the greatest abundance, and attain the largest size. The tropical parts of this continent possess more reptiles than those of Asia or Africa according to late returns; but probably when the interior of the latter country becomes better known to naturalists, its forests and morasses may prove the habitats of many species now unknown. As we proceed from the equator to the poles, we find reptile life gradually decreasing until we arrive at the borders of arctic Europe, Asia, and America, beyond which barrier no species have, as yet, been found. Very few reptiles reach the north boundary of the temperate zone, taking the isotherm of 30° for its limit, the frogs and salamanders appearing to go the farthest north. In regard to reptile life in elevated districts, we find that on the European continent the common frog (Rana temporaria) has been found 8,000 feet above the sea level in the alpine districts, in the vicinity of the snow limit; the viper (Pelias berus) five thousand three hundred feet; the mountain lizard (Lacerta montana) at four thousand five hundred feet; and the slow-worm (Anguis fragilis) at six thousand feet; while on this continent, the alligator (Alligator lucius) has been observed in the Andes, about the latitude of the equator, at an elevation of three thousand feet, where the temperature ranges from 63° to 73°.

With this brief introduction, I will now pass on to the reptiles of our own Colony.

In considering the habits of our Nova Scotian reptiles, we can not fail to observe that the ophidians are much influenced by the temperature of the seasons; and from other causes also, which I have not yet been able to account for, they are found some seasons in great abundance, while during others hardly a dozen specimens are observed in the same district. I have had ample scope for observation during the past four years of my residence here, in the forest and cultivated land about my home, and have paid particular attention to the habits of this order, collecting specimens of all sizes, from the embryo taken from the egg to the perfect example of the

largest size. I have had similar opportunities of studying the habits of the batrachians, but with the members of the order *Testudinata* it has been otherwise. Nevertheless, through the kindness of one of our members, I am enabled to fill this blank, and present to you a fair account of the reptiles of our Province.

The first order in the class *Reptilia* is that of the *Testudinata* or tortoise tribe, and of this Nova Scotia possesses three species—the alligator terrapin, or snapping turtle (Chelydra serpentina), painted tortoise (Emys picta), and the wood terrapin (Emys insculpta). The second order *Loricata*, comprising the crocodiles and alligators, has happily no representative in this northern clime. The third order *Sauria*, including the lizards, has also no representative. The fourth order *Ophidia*, to which all the serpents belong, has five well ascertained species—the black snake (Coluber constrictor), the striped or spotted snake (C. sirtalis), the green snake (C. vernalis), the ringed snake (C. punctatus), and the spotted neck snake (C. occipito-maculatus). We come now to the sub-class *Amphibia*, which contains in the first order *Anoura*, the frogs and toads. Of these Nova Scotia possesses seven recognized species—the bull-frog (Rana pipiens), the spring frog (R. fontinalis), the leopard frog (R. halecina), the wood frog (R. silvatica), the American toad (Bufo Americanus), Pickering's hylodes (Hylodes Pickeringii), and the northern tree toad (Hyla versicolor). The second order of amphibians *Urodela*, contains the salamanders, of which we have four species—the violet coloured salamander (Salamandra sub-violacea), the red-backed salamander (S. erythronota), the salmon coloured salamander (S. salmonea), and the crimson spotted triton (Triton mille-punctatus. These comprise the whole of our Nova Scotian reptiles, at least as far as I have been able to ascertain.

Order—TESTUDINATA.

Genus—CHELONURA, Flem.

Chelonura serpentina, DeKay..... Snapping Turtle.

Testudo serpentina—Linn. Syst., p. 354.

Chelydra lacertina—Sch. Monog.

Emys serpentina—Gray, Synops. Rept. apud Griff. Cuvier, vol. 9, p. 14.

Emysaurus serpentina—Dumeril & Bibson, vol. 2, p. 350.

I am indebted to Dr. GILPIN for the following information regarding this species:—"The snapping turtle is found in the larger lakes of the colony, being aquatic in its habits. It has often been observed beneath the ice during winter. It is occasionally taken on land, while travelling from one lake to another, or when depositing its eggs. One caught in the latter position was about two feet long, and boys of twelve years old easily rode on its back by standing on it. The shell scarcely encases the head, legs, and tail. The tail has four or five sharp points on its upper side; the under shell very small, a mere breast plate. In 1833, while with some Indians in a canoe on Lake Rosignol, we came upon a snapping turtle basking on a log. With the greatest caution we floated with a light breeze to within twenty yards of it, when, with a heavy splash it disappeared. Marking the exact spot, in a moment the canoe was swept over it, and an Indian held the turtle to the bottom of the lake by pressing the paddle upon his back, while another Indian drove a stake through its body and lifted the turtle into the canoe. After decapitation the body crawled about for some twenty-four hours or more, and the severed head snapped at wood, and held so tight that force was used to disengage it.

Genus—EMYS, Brong.

Emys picta—De Kay.....The Painted Tortoise.
Testudo picta—Gm. Schneid, Schildk, p. 348.
T. cinerea—Schœpff, Hist. Test., p. 23, pl. 4.
Emys bellii—Gray, Synops., p. 12.

This pretty little tortoise is found in abundance about the small lakes, ponds, and ditches of the colony, where a dozen may be seen together basking on an old log, and when surprised going off with an awkward yet swift plunge. It may easily be kept in confinement in a tub of water, and will, when domesticated, rise to the surface, and take a worm from the hand. In such a position it has been known to lay an egg, which was hard and about an inch and a half long. The young of this species, about the size of a penny piece, may be seen in the lakes resting on the point of a water lily leaf.

Emys insculpta—DeKay.....The Wood Terrapin.
Emys pulchella—Schweig, 303.
E. scabra—Say, Journ. Acad. Nat. Sc. Phil. iv., 204.
E. speciosa—Gray, Syn. 26.
E. inscripta—Mus. Par.

This species is generally found at a distance from water in the forest, but goes into the lakes and burrows beneath the mud during winter.

Order—OPHIDIA.
Genus—COLUBER, Linn.

Coluber constrictor—Linn..... Black Snake.
C. constrictor—Shaw, Zool., p. 464.
C. flaviventris—Say, Exp. Rock. Mount., pp. 167, 337.
Bascanion constrictor—Baird & Girard, Cat. of Serp., p. 93.
Coryphodon constrictor—Dunn & Bibr. vii. p. 183.
C. constrictor—Gunth. Cat. of Col. Snakes, p. 108.

Although this species is very rare in the neighbourhood of Halifax, I imagine it is common in the interior of the colony, from information I have received. A coloured man some time ago informed me, that one of these snakes had chased him when a boy the whole length of a field. I thought at the time that his account was much exaggerated, but I find from the best authorities that this habit of chasing an enemy is fully established, and that its force on such occasions is very great.

This snake appears to be widely distributed on this continent, being known from Canada to Mexico. It is also found in St. Domingo, and, according to Stedman, in Surinam.

Coluber punctatus—Linn ..... Ring-necked Snake.
C. punctatus—Lacep., ii. p. 257.
C. torquatus—Shaw, Zool. iii. p. 553.
Homalosoma punctatum—Wagl. Syst. Amph., p. 191.
Spilotes punctatus—Swain's Nat. Hist., p. 364.
Calamaria punctata—Schleg. En. ii. p. 39.
Ablabes punctatus—Dum. & Bibr. p. 310.
Diadophis punctatus—Baird & Girard, Cat. Serp. p. 112.

A specimen of this prettily marked species given to me by Dr. Gilpin was taken at Annapolis. Another, given me by Mr. Downs,

captured by some men working at a drain in his grounds on the 7th September, 1863, was marked with a bright orange band round the neck, and the abdomen bright lemon colour. From it I made the following description :—

Length, 11½ inches. Extreme breadth of head at broadest part across base of large occipital plates, 2½lines. Breadth of body 2½lines at a distance of 3in.4lines from frontal extreme, which is not exceeded at any other part. Head, flat. Breadth of yellow collar ¾ of a line. Tail 2in.7½lines.

Colour—Head, above, very dark steel blue; nasal scales brownish. Irides, above, reddish. Immediately behind the head a collar of orange yellow, margined with black, separates the head from the body. Upper jaw edged with yellow; deeper posteriorly. Upper parts, olive brown, fading into light steel blue at the sides. Beneath, bright yellow from neck to base of horny tip of tail. Chin and throat very light yellow. On either side of the yellow belly run a series of dark spots at the posterior angle of each abdominal plate, very obscure and almost absent for a space of 3½ lines from the collar. Under the lens the dorsal scales appear mottled and the occipital plates of pearly lustre. Abdominal plates 156.

This snake is by no means common about Halifax, and may be considered our rarest snake.

Coluber vernalis—De Kay ..... Green Snake.
C. vernalis—Hall, N. Am. Herpet. iii., pl. 17.
C. cyaneus—Shaw, Zool., p. 506.
Chlorosoma vernalis—Baird & Girard, Cat. N. Am. Serpents, p. 108.

This delicate little snake is very common about the grass fields and cultivated spots. Specimens vary in colour, some being of a much lighter green than others. It is very agile in its movements, gliding through the grass when disturbed, with rapidity. According to Baird this snake is northern in its distribution, extending from Maine to Wisconsin in the United States, but no further south than Virginia on the Atlantic coast. I have observed it about as early as the 6th May. Cats appear to delight to catch these snakes as they run through the grass.

Dr. Gunther in his British Museum Catalogue of Colubrine Snakes, appears to object to this species being included in the genus *Chlorosoma,* as Baird & Girard have done; for he states that that genus was established by Wagler for *Philodryas viridissimus,* and that the snakes differ too much from one another.

Coluber sirtalis—Linn. . . . . Spotted Snake.
Tropidonotus tœnia—DeKay, p. 43, pl. xiii., fig. 27.
" *sirtalis*—Holb., N. Am. Herp., vol. iv.,
Eutœnia sirtalis—Baird & Girard, N. Am. Serp., p. 30.
Eutœnia sirtalis—Baird, Serpents of N. York, p. 15, pl. i., fig. 5.

This is by far the most common snake in Nova Scotia, being abundant in all parts of the colony. Although continually observed in the dryest positions in the forest, it nevertheless appears to prefer the neighbourhood of swamps, brooks, and damp places, where it leads a partially amphibious life during the hot season. The largest specimens I have seen were in such places, and one which I killed during the latter part of the summer of 1863, resting on a log in a swampy hollow, measured two feet eight inches in extent. It generally makes its appearance in the forest about the first week in May, but is much more numerous some seasons than others. During the months of June, July, and August, 1864, scarcely one of these snakes was to be seen in my district, but in September of that year they appeared in abundance. A sudden spell of cold weather appears to have a great effect upon them, as they all disappear at once until returning heat brings them forth again. They shed their skins among ground juniper (Juniperus communis) and other shelter in June, and retire to winter quarters after the first cold days of autumn. I have observed them as early as the 4th of May, and as late as the 7th of October. The young, some four inches long, are seen about the beginning of September. The full grown specimens may frequently be seen by the sides of brooks in the forest, greatly distended with recently swallowed prey, the common toad (Bufo Americanus), probably from its sluggish habits, forming their principal food. On the 1st September, 1864, I witnessed the process of deglutition. A spotted snake, about twenty inches long, had just seized a good sized toad by the right hind leg, which it gradually drew into its maw. Then turning its head sideways, after some difficulty, it secured the foot of the left hind leg, and gradually got this down, when it gave a sudden shake and took a firm hold of the hinder parts. Now, moving its head with the jaws greatly distended, first to one side and then to the other, the toad meanwhile holding with all its might by the two fore feet to

the ground, and the snake getting more and more into his maw, the toad's back covered with blood and froth, and the poor captive panting hard. The snake then gradually drew in the distended body of the toad until it reached the head, when, with much apparent trouble, it managed to draw in the fore legs and head. The whole scene occupied about twenty minutes, and was extremely disgusting to witness. The most curious part of the affair occurred at the last, when the poor toad with open eyes gradually receded from view down the throat of the snake.

It is apparently a good swimmer, for the Rev. JOHN AMBROSE informs me that it has been observed a mile or more from the shore at the entrance to St. Margaret's Bay, making for the islands outside.

When greatly irritated by stopping its course repeatedly with a stick, this snake will turn about and show fight, making rapid and repeated bites. It is however perfectly harmless, and its bite would entail no greater suffering upon any healthy person than that of a kitten. It is said that this snake has repeatedly been seen to swallow its young in time of danger, and from evidence received from reliable authority, I have hardly a doubt but that it possesses this curious habit.

This snake appears to be distributed over the greater portion of the North American continent east of the Mississippi, and has been found at an altitude of two thousand feet above the sea in the State of New York. It occurs abundantly in Canada, where it is said to be particularly common in the rocky limestone districts. In Massachusetts it is the most common snake, and it has been observed as far north as Lake Winnipeg by Sir John Richardson.

Coluber occipito-maculatus—Storer.... Spotted-neck Snake.
Ischnognathus occipito-maculatus—Gunther, Cat. of Col. Snakes, p. 81.
I. DeKayii—Dunn & Bibr. vii., p. 509.
Coluber venustus—Hallon, Proc. Acad. Nat. Sc. Philad. iii., p. 274.
Storeria occipito-maculata—Baird & Girard, Cat. p. 137.

It appears that this small species was entirely overlooked by North American collectors until within a comparatively recent

period. Storer was the first to bring it to notice. That author states that it has three spots on the neck, but I find a smaller spot below the two side ones, joining with the mottled margin of the underside. I think these spots on the neck are liable to alteration, sometimes being partially absent, and at other times confluent, while in some cases there are no traces of the marks at all. It is liable to considerable change of colour—for two specimens which I took from a heap of weeds were of a bright cinnamon above and brick red beneath. These light coloured specimens may belong to different species, for the scales appear to me to be much wider and shorter, and possess blunter points, than those of the true *occipito-maculatus*. They resemble in some respects the red snake (*C. amaenus*) of DeKay, but the scales instead of being smooth, as in that serpent, are carinated.

They are fond of lying under pieces of wood or stones, where they can feel the sun's warmth, and are common in old heaps of refuse, roots, &c.

This snake is not uncommon near Halifax.

Order—ANOURA.

Genus—RANA, Linn.

Rana pipiens—Harl..... Bull-frog.

R. pipiens—Holb. N. Amer. Herpet. iv., p. 77, pl. 18.

R. catesbiana—Shaw, Zool. iii., p. 106.

R. mugiens—Gunth. Cat. Bat. Lal., p. 15.

I have had no opportunity of studying the habits of this species, as it is unknown in the neighbourhood of Halifax, and the only examples I have seen were those exhibited by Captain Hardy at our conversazione last summer in the hall of the Horticultural Society. Captain Hardy informs me that they are common at Grand Lake; and the Rev. John Ambrose states that they have been known to swallow young ducks.

Rana fontinalis—Le Conte.....The Spring Frog.

R. fontinalis—Holb. N. Amer. Herpet. vol. iii., p. 85 pl. 16.

R. flavi-viridis—Harl. Am. Journ., vol. x.

This species occurs abundantly in Nova Scotia, and may be styled the "common frog" of the country. It frequents the

swampy districts, lakes, and ponds, where its peculiar note, like a half broken croak, is heard all day long. Sitting at the edge of a pond, with its head only exposed, it expands its throat at intervals and gives vent to the well known sound. If suddenly disturbed it instantly dives beneath the surface, and if the water be shallow buries itself beneath the mud and leaves at the bottom. It delights to spend the warm days of summer in company with its fellows, partially immersed in the water, but in the hottest and dryest weather disappears entirely during the day time. I have no doubt but that these hottest days are spent beneath the mud, for I have seen one of my Newfoundland dogs when diving in play bring one up alive to the surface on such a day. I observe that this frog croaks oftener and louder in close wet weather, and that a slight frost has the effect of making it silent. It is rarely seen at any distance from water, and immediately makes for that element when disturbed. It is pretty regular in its appearance in spring, but moves from its winter retreat sooner or later, according to the temperature of the season. In 1862 I heard the first croak of this species in my pond on April 27th; in 1863, on April 25th; in 1864, on April 25th; and this year, 1865, on April 6th, and these first croaks were invariably heard at night. I observed the first spawn in the pond in 1863, on May 3d; in 1864, on April 30th; and this year, 1865, on April 10th. Their early appearance and deposition of spawn this year has been owing to the extreme forwardness of the season, vegetation being fourteen to twenty days earlier than during the four previous years. It attaches its spawn to small twigs or sticks at a moderate depth beneath the surface of the water, and I have reason to believe that the act of deposition occurs only during the hours of night. The tadpoles of this species hibernate in the mud like the parent, and appear about the same time in the spring of the year, some of them full grown, but with the umbilical cord attached.

Rana halecina, Kalm ..... Leopard Frog.

R. halecina—Holb., N. Amer. Herpet, iv., 9, 91, t. 22.

R. Virginiana—Lawr. Syn. Rept., p. 31.

This is by far the handsomest species of frog seen in Nova Scotia. It is generally found in moist places, although I have occasionally taken specimens some distance from water among standing grain.

it is extremely agile and difficult to capture, taking amazing leaps in its endeavours to escape. The half grown young are plentiful on the sides of ponds during the summer, but they have not the brilliant colours of the mature specimens. I have rarely seen them resting in the water like *R. fontinalis.* I have observed them as early as the 29th of April, sitting on the pond side, and as late as the 4th of October in other places. The first specimens seen are of a darker green on the back than those observed later in the season.

The species is common in most parts of North America, and is known from the Hudson Bay Territory as far south as Mexico.

Rana silvatica—Leconte..... Wood Frog.
R. silvatica—Holb., N. Amer. Herpet, iv., pl. 24.
R. Pennsylvanica—Harl. l. c. p. 60.

The habits of this species are unknown to me, as the only specimen I have captured was a young one during our field excursion at Windsor, in the summer of 1863. I am indebted to Dr. GILPIN for a fine specimen procured.

Dr. Gunther in his catalogue of Batrachians gives this as merely a variety of the European *Rana temporaria,* the tympanum being generally but not always rather larger in the European specimens.

This species has been observed as far north as the Great Bear Lake in the Hudson Bay Territory.

Genus—BUFO, Linn.

Bufo Americanus—Harlan..... American Toad.
B. Americanus—Holb., N. Amer. Herpet, v. t. 4.
B. musicus—Harl. Ac. Nat. Sc., vol. v., p. 344.

This poor, despised, yet useful creature, looked upon with horror by most people, is one of the farmer's and gardener's best friends. Sallying forth from his mid-day retreat at eventide, he searches the paths and other likely spots where slugs and worms are wont to move, and revels in the gardens where this welcome food is most abundant. Although nocturnal in habit it is by no means exclusively so, for I have often taken them in the day time, both in the forest and clearing. It is not, however, so active in the day time as at night, and I imagine its appearance in broad daylight is more owing to disturbance than a natural desire to seek for food

at that time. It appears to frequent the cultivated districts more than the forest, although the largest specimen I ever obtained was found in the day time in an uncleared spot in a hard-wood grove. This specimen measured four inches and a half in length, including the head, which was one inch and four lines, and three and a quarter inches in breadth of body. About the end of May the young, about an inch long, are often seen hopping about, and then gradually increasing in growth, as the summer advances, continue about until the first sharp frosts of October and November compel them to seek their winter retreats. I have never observed them about later than the first week of November.

It appears to be common in all parts of the North American continent, extending from Great Bear Lake in the Hudson Bay Territory to Mexico.

Genus—HYLODES, Fitz.

Hylodes Pickeringii—Holb. . . . . Pickering's Hylodes.
H. Pickeringii—Holb. N. Am, Herpet, pl. 34.
Acris Pickeringii—Gunth. Cat. Bat. Sal., p. 71.

For three years I laboured under a great mistake in regard to the note of this little frog. Often had I listened at all hours of night to its shrill piping noise, and always gave the common frog (R. fontinalis) credit for the strange nocturnal sound; but Capt. Hardy informed me that the musician was no other than Hylodes Pickeringii, several specimens of which he exhibited at our conversazione last summer. It is by no means easy to collect specimens of this species, for although I have searched and searched again with a bright lantern on summer nights, when they piped loudest, I have never yet been able to procure one. Capt. Hardy states that they are seen attached to the reeds and stems of aquatic plants a few inches above the water, and that the first object which attracts the collector to their resting place is the movement of the throat as each little frog continues its piping noise. The curious cruciform rhomboid of dark lines on the back, and the triangular patch on the occiput at once prove it to be distinct from the young of other species frequenting the same places. In 1863, I heard its first pipe in my pond on the 28th of April; in 1864, on the 25th of April; and this year, 1865, as early as April 7th. I have generally heard

the first pipe of this frog one night later than the first croak of *R. fontinalis.* It is like that species very silent during drought.

Genus—HYLA, Laur.

Hyla versicolor—Leconte. . . . . Northern Tree Toad.
H. versicolor—Holb. N. Am. Herpet. iv., pl. 28.
H. verrucosa—Dand. Rain., p. 33, pl. 4, fig. 1.
Dendrohyas versicolor—Tschudi, Batr., p. 75.

I am enabled to add this species to the list of Nova Scotian reptiles, through the kindness of Capt. HARDY, R. A., who informs me that although he has never been fortunate enough to secure a specimen, yet from the description given him by a young Indian who collects for him, he has not the slightest doubt as to the species. His informant states that he has found it snugly ensconced in clefts of maple trees, where, from its grey colour harmonizing with the lichens growing on the bark of the tree, it was difficult to observe. Capt. HARDY tells me that the pipe of this tree toad is similar to that of Pickering's Hylodes, although much louder, and that it is more vociferous during damp foggy weather.

It is found throughout the whole extent of the North American continent, from the Hudson Bay Territory to Mexico.

Order—URODELA.

Genus—SALAMANDRA, Brong.

Salamandra subviolacea—Harl. . . . . Violet-coloured Salamander.
S. subviolacea—Holb. N. Am. Herpet, vol. iii., p. 105, pl. 24.
S. venemosa—Barton, apud Dand. Hist. Rept., vol. viii. p. 229.

This is a common species, and is found under large stones, in old walls, roots of trees, &c. It is very sluggish in its habits, and scarcely moves when handled.

It appears to be extensively distributed over this continent, being found in the Western States, all along the Atlantic coast, and as far south as Maryland.

Salamandra erythronota—Holb. . . . . Red-backed Salamander.
S. erythronota—Harl. Med. and Phys. Researches, p. 95.
S. cinerea—Id.
Plethodon erythronota—Baird, l. c. 285.

This species is by no means common in the neighbourhood of Halifax. It frequents damp places where it rests concealed beneath stones and other shelter. It is known on this continent as far south as South Carolina.

DR. GILPIN'S *Red-bellied Salamander.*

DR. GILPIN informs me there is yet another salamander, having the under parts red. This may be the Salmon-coloured Salamander (S. salmonea) which has its sides salmon-coloured. It is known in Massachusetts, and may therefore occur in this Province.

Genus—TRITON, Laur.

Triton millepunctatus—DeKay.....Crimson Spotted Triton.

Salamander dorsalis—Harl. Jour. Acad. Nat. Sc., vol. vi., p. 101.

Notophthalmus viridescens—Baird, Batr. Amer., p. 284.

This species is rare in the neighbourhood of Halifax. The only specimen I have seen being the one in my collection for which I am indebted to Captain HARDY, who obtained it from Mr. J. R. WILLIS.

Storer, in his Reptiles of Massachusetts, complains that Harlan, in the Journal of the Academy of Natural Sciences, Philadelphia, describes this species as having "a row of whitish coloured oblong spots on each side of the dorsal line." Now, in my specimen, although the white spots cannot be called oblong, they are certainly clearly defined dots of the colour Harlan mentions. It is true, as Storer says, that preservation in spirits may make this alteration, but nevertheless we frequently find descriptions, given even by the best authorities, from specimens of all kinds so preserved, although I think it would be well for every describer to state the condition of the specimen, whether long immersed in spirits or not. The specimen I possess has been in alcohol for about two years.

In concluding this brief account of the reptiles of this colony, I cannot help remarking how thankful we ought to feel that no poisonous snake is found within our borders. Even England, with all her advantages, has a drawback in this respect, for in many parts of that country, on the heathery moors of the north, and in the fertile valleys of the south, the bite of the venomous adder is too well known. Often have I started back with a shudder, when in

searching for birds' nests, in some wild spot, I have suddenly come upon an adder basking in the sun, and one half the pleasure of a day's wanderings in search of specimens was always sacrificed to the fear of this serpent's bite. In the northern States of America, the dreaded rattlesnake swarms in some parts, the bite of which is frequently fatal in twenty minutes; while here, in our little half-island home, our children may ramble wherever they list, and meet with nothing more formidable than the bite of the common striped snake, which at the worst can only inflict a slight wound in no way dangerous to a healthy frame. Therefore, while in other climes which boast of the grandeur of their scenery, the beauty of their vegetation, or the vast area of their fertile lands, deadly foes are ever ready to spring upon the incautious, here in our northern home we may roam through the forests, scale our boulder ridges, or bathe in the limpid lake, without hindrance from any reptile form. Surely we ought, therefore, to consider how blessed we are in this respect, and while considering the blessing let us not forget the beneficent hand that has so blessed us; and as we roam in security amid Nature's pleasantest scenes, let us lift our eyes in gratitude to Him who has spared us the horrors of the serpent's fang.

Art. XIII. Notes on the Economic Mineralogy of Nova Scotia; Part II. The Ores of Manganese and their Uses. By Henry How, D. C. L., *Professor of Chemistry and Natural History, University of King's College, Windsor.*

(*Read May* 2, 1865.)

A very interesting, and to all present appearances, valuable addition to the mining industry of the Province, has been made within the last three years by the working of the ores of manganese. Having been engaged in examining and reporting on the quality of these ores for those originally concerned, and having visited the scenes of operation, I requested and obtained permission to include such information I had gathered by these means in a general account of the manganese ores of the Province at present known to me. Having been, moreover, kindly furnished with sundry details of interest from various sources, I propose now to continue, on this subject, my Notes on the Economic Mineralogy of Nova Scotia, of

which the first part was published in the last volume of the Transactions of the Institute.

The only deposits of manganese mentioned in Dawson's Acadian Geology are an impure bed near Cornwallis bridge, that at Musquodoboit, and those in the iron veins of Shubenacadie and in the limestones of Walton and Cheverie, of which latter it is said (p. 239) "small quantities have been exported. I have no doubt that if the limestones can be profitably quarried on a large scale, the manganese might be separated and form a considerable additional source of revenue; but it seems doubtful whether mining operations for the manganese alone can be carried on without loss."

The ores of manganese found here in quantity are Wad or bog ore; Manganite, which may be called hard grey ore, and Pyrolusite, which may be distinguished as soft black lustrous ore, and is often mixed with psilomelane, a hard black ore not so lustrous as the last named.

Wad.—The first of these is a black earthy substance, which is found in rounded lumps and grains. It has been sent to me from Parrsborough, and from another locality, I believe to the east of Halifax, where it is found in lumps mixed with stones; the sample I examined contained a great deal of water, and, when dried, 56 per cent. of binoxide of manganese, with the traces of cobalt which are usually found in this species. Neither of these would be valuable as ores of manganese, but they would probably serve as paints. Bog manganese is often mixed with bog iron ore, and then forms deposits of a brown or chocolate colour, called ochres or mineral paints. The paints of Bridgewater and Chester furnish examples. In the first of these I found only 11 per cent., and in the second about 20 per cent. of binoxide of manganese. It is said to be useless to send to (the English) market ores containing less than 65 per cent. binoxide.

Manganite.—This is a very hard ore which is found in compact lumps of a steel grey colour and sub-metallic lustre, giving a reddish brown streak to a file. It is often found in the neighbourhood of the next mentioned; it occurs abundantly at Walton and Cheverie, and is met with at Douglas and Rawdon. At Walton I have picked it out of the stoneheaps in fields near the river, and was told that a bed of it crops out on the bank of the river near

the bridge. It is found at Cheverie in nodules on the beach about twenty rods above high water mark, and has been dug on the upland less than two miles from the beach; it was formerly shipped, but to what extent does not appear to be known. As it is very hard, and contains in its purest form only about 49 per cent. *binoxide*, this ore is not useful for the ordinary applications of manganese; but I was informed by a gentleman from Boston, dealing in these ores, that it answers for a certain secret process better than the rich soft ore, and that something like fifty tons were sold in the United States in 1863, and that it was hoped the demand would increase.

Pyrolusite.—This is the ordinary marketable ore, and is entirely composed of binoxide of manganese. It is so soft as to be easily scratched with a knife to a black powder, and is found in masses which are more or less glistening, and often very beautifully crystallized in black lustrous needles and prisms. It is met with near Kentville, King's County; near Pictou, Pictou County; near Amherst, Cumberland County; at Musquodoboit, Halifax County; and at Walton, and other places, especially at Teny Cape in the township of Kempt, in Hants County. These two latter are the only localities at which mining operations have been carried on, small quantities of ore having formerly been shipped from Walton, where, on one occasion, seven barrels were got out in cultivating a garden, and considerable returns, as will presently appear, having been made at Teny Cape. In 1861 Nicholas Mosher, Esq. junr., of Avondale, brought me samples from Teny Cape which I examined for him, and when he learned what the substance was he sought for it diligently and procured several fine specimens, some of which he sent to the International Exhibition of 1862. He found the ore to occur about a foot below the surface, in a bed of earth about a foot thick, in separate loose masses, generally flattened in shape, of all sizes, from that of a bean up to that of the lump of twenty-four pounds weight, which, as being the largest then met with, was sent to the Exhibition. In this mode of occurrence it was traced some fifty rods; subsequently it was found in thin veins in the rock under this earth, the rock being "brick-like" and easily detached with a pick, so as to leave sheets of the ore. In one place four veins were found in ten feet, the largest vein being about one and half inch thick. Diggings were

made to the depth of four or five feet, and the ore became more plentiful, but was so variable in amount that while on one occasion two and a half barrels were got by a man in one day, the average quantity obtained was about half a barrel per day per man. This variation arises from the ore occurring not in regular veins but in separate masses, often lenticular, in pockets of various sizes. The first considerable collection of ore sent from the mines was landed at Windsor in June 1863, for transmission to England. It consisted of thirty-three barrels, equal to about seven and a half tons English; it was picked ore and looked very rich and uniform in quality; the highest percentage of binoxide I know of from Teny Cape was found in a sample I put in the hands of Mr. D. Brown, a pupil of mine, who obtained 95 per cent., and when this lot of ore was sent to England, it averaged on analysis in Liverpool 91·5 per cent. binoxide, and gave less than half a per cent. iron: it sold there half for £8 10s., half for £9 sterling per ton, being disposed of to different buyers. Messrs. Tennant of Glasgow, great consumers of manganese, are reported to have said they had never seen ore so fine. In April 1864, what appeared to be a vein of five feet two inches thick was struck; I visited the mine in June, and saw many tons of ore piled up, and one huge mass of perhaps three tons weight laid bare *in situ*. Mr. John Browne, the manager of the mines, has obligingly furnished me with a report, dated February 16th, 1865, from which I give some extracts: after narrating the facts I had learned from Mr. Mosher, given above, he says: "On the south side of the ridge a large open cutting was brought in running nearly north and south, in which was discovered the first large deposit at a depth of only fifteen feet from the surface. It extended some twelve fathoms in length, varying in thickness from fourteen feet to as little as six inches. From this pocket we took from one hundred and twenty to one hundred and thirty tons, leaving nothing in the bottom but a few small veins. Upon these we sank our shaft, and at a depth of fifteen feet, making in all thirty feet from surface, we intersected pocket No. 2 immediately underneath the first deposit, and making in the same direction. The manganese in the second pocket is of far superior quality to that found nearer the surface, and we have returned from it some hundred and eighty tons. Up to the present time we have been

opening ground and prospecting. In conclusion, I beg to state that our prospects are daily improving, and I firmly believe that at no distant date the manganese mines of Teny Cape will hold a distinguished position in the list of *bona fide* and profitable mines of Nova Scotia."

I have omitted a number of technical mining details, allowing the extracts to bring out the mode of occurrence, the richness and quantity of the ore yet obtained: it appears that upwards of three hundred tons have been got out. Two hundred tons more have since been taken out, and very fine ore of 93·8 per cent. has been found at 50 feet below the surface. As regards the quality, I believe all that has been sold in England has realized from £8 5s. to £9 stg. per ton*; the beautiful specimens sent to the Dublin Exhibition this year, are, I apprehend, mostly from the second pocket, as I received the majority on February 4th; the large mass, however, of about three cwt., which has so long lain at the door of the Halifax Reading Room, and is, by the liberality of Messrs. Nash and Co., also to be sent to Dublin, I imagine must be from the first pocket.

The second mine in operation at Teny Cape, was opened up by Messrs. Weeks & Co. In the spring of 1864 samples of ore were brought to me by O. Weeks, Esq., and J. W. Ouseley, Esq., which turned out to be sufficiently rich for working, as they gave, just as I received them, from 88 to about 92·5 per cent. binoxide. In June I went with Dr. Weeks, of Brooklyn, and a party, to prospect the locality whence the samples were taken. It consisted of a considerable hill contiguous to the Mosher mine, and the indications of ore in various parts were very promising. Operations were soon after commenced, and during the year about eight tons, English, of ore were sent to Liverpool, where they realized £8 5s. stg. per ton.† One great advantage of this locality is, that the Basin of Minas is only about a mile and a half distant in a direct line, and the intervening country is such that a road can easily be made from the mines to the place of shipment.

Hants County possesses a variety of manganese ores in localities widely separate from each other; it has been mentioned that seven

* About ten or twelve tons fetched £10 per ton.

† A third mine has been opened by Messsrs. Hamilton & Duvar, and a good deal of ore has been raised.

barrels of ore were on one occasion dug up in cultivating a garden at Walton; of the quality of this I know nothing, but that valuable ore is found at Walton I am certain inasmuch as a party of which I was one extracted several pounds at a locality in the woods about seven miles from Teny Cape; one piece of this is sent to the Dublin Exhibition, and is quite as rich to all appearances as that from Teny Cape.* About twelve miles south of these places Mr. Mosher has met with large detached pieces of ore, one weighing thirty-five pounds was sent to the Exhibition of 1862 and remains in England; it consisted of *pyrolusite* and *psilomelane;* it gave to Mr. Poole, one of my pupils, about 84·5 per cent. binoxide; another large mass found in the same region weighed one hundred and eighty-four pounds. I do not know of what kind of ore it consisted. The rock holding the manganese at Teny Cape is a limestone containing a good deal of magnesia, and coloured either grey or red by oxide of iron; it is soft and easily detached from the ore; barytes is frequently seen crystallized through the ore, and carbonate of lime (calcite) is sometimes found beautifully crystallized in various forms encrusting the ore. At Walton the manganese is sometimes associated with iron ore (limonite), and occurs in limestone. Since nearly all the localities mentioned in a previous page as affording manganese are of lower carboniferous age, it is not improbable that many others may yet be found in the Province, where rocks of this age are so abundantly distributed. It is not, however, in such rocks only that manganese may be expected, since it appears by the Report on Mines and Minerals of New Brunswick, by Prof. Bailey, issued in 1864, that the deposits of manganese, with one exception, in that Province, are met with either in lower silurian or cambrian rocks (p. 71); the exception is a bed said to be alluvial (p. 33). As regards the mode of occurrence it is stated (p.72), that manganese is generally found in quartz or barytes, especially the latter, the country-rock being slates; at one locality (p. 45) the slates enclose a bed of limestone, three or four feet thick, which contains the manganese; the alluvial locality is also said to have the manganese in limestone; in all cases the

* Five tons were afterwards taken out here by Mr. J. Browne.

† In a report issued in 1865, and received since this paper was read, I find that Professor Bailey places the manganese localities in New Brunswick at the base of the lower carboniferous series.

geological situation is different from that prevailing here. I may mention that the report gives twelve hundred and fifty tons as the amount of ore taken account of as raised and mostly sold; a large but unknown quantity besides is mentioned as having been raised and shipped, and much must have been used in the Province, since there were at one time large chemical works at the Hopewell manganese mines in Shepody mountain.

Canada, it appears, has not yet been found to possess manganese ores in sufficient purity or abundance to be of economic importance —(*Geology of Canada, p.* 751.) The chief supplies of these ores were till lately derived from Germany, but mines have been opened not only here and in New Brunswick, but in Spain and Vermont; and it was from Spain, according to a Report read before the British Association in 1863, that the richest ores were at that time mostly imported into England. A short extract from this report will probably be interesting as showing that Nova Scotia has richer and more accessible ores than Spain:—

"Manganese is imported from Germany and Spain; but it is chiefly from the latter country that the richest ores are now obtained, which are found in hills consisting of schistose rock, which sometimes rise to a height of eight hundred feet above the level of the plain; but it is also found in "pockets," and, in the latter case, it is quarried by picks, and occasionally gunpowder is used. The quality of the ore varies from 50 to 90 per cent. peroxide, and to obtain the richer ore men and boys are employed to break and sort it, which is then put into sacks and carried a distance of twenty to thirty-five miles, on mules' backs, to the ports of shipment in the Mediterranean. The richest ores are at Calanas, thirty miles north of the ancient Roman fishing town of Huelva. We are indebted to Mr. Gething for this information, who also informs us that he imported to the Tyne, in 1857, the first cargo of Spanish manganese."

As regards Vermont, it appears from Dana's Mineralogy that the ores are abundant at several places; whether they are worked at more than one I have not learned. The locality at which mining is prosecuted is Brandon; and from the following interesting information, communicated to me by Dr. W. H. Weeks, of Dartmouth, it appears that the mode of occurrence of the ore is very different from that at Teny Cape, and by no means so favourable for operations on a large scale:—

"My visit to Brandon, Vermont, was of very short duration; I spent only a few hours at the works, consequently had not time to study the locality. The manganese is taken out of a gravel bank; it exists in

very small pieces, varying in size from that of a pea to a small onion; it is compact, very black, and does not show the crystal as ours does. There is iron ore, said to be very pure, taken out of the deposit, and an ochre largely charged with oxide of iron. The process of obtaining and cleaning the manganese is slow and must be expensive; they wash it in pans by a process something similar to that adopted here for the separation of gold from powdered quartz. The quantity of manganese at the Brandon mines is very small in proportion to the amount of material operated on compared with ours. The Brandon manganese is very pure when thoroughly cleansed, but this is a difficult matter as the oxide of iron adheres tenaciously."

Uses of Manganese Ores.—These ores are employed for a variety of purposes in certain manufactures of purely chemical character, or in which the aid of chemistry is necessary, and according to the application to be made of them they are required of different degrees of purity: in most cases a tolerably high percentage of the particular oxide of manganese, called the binoxide, peroxide, or available oxide, is necessary, and for certain uses there must be little else in the ore, and especially iron must be either absent or present in extremely small proportion. The manufactures in which the ores are used are principally those of bleaching powder, glass, pottery, iron, some brown colours used in dyeing, and manganates and permanganates for certain oxidizing processes (as bleaching fats) and for disinfecting. The native oxide is used for making boiled oil, and has also been recommended as a deodorizer and purifier of water, and a cheap agent for extracting gold from quartz.

It is perhaps impossible to learn the total consumption of the ore for these purposes; we know, however, that Great Britain is the great seat of the chemical manufactures, and we have some facts to guide us to an estimate of the amount used there in the processes requiring the largest quantity; these I will now give, together with a rough estimate of the consumption in the United States. The most extensive use of the ore is in the making of bleaching powders (chiefly chloride of lime). According to the report previously quoted, the amount of manganese imported into the Tyne district alone for this purpose was then (1863) given as 11,400 tons per annum, at £4 stg. per ton. Although this district is a very considerable seat of chemical manufactures, there are other parts of the Kingdom where very large quantities of manganese are required, among which, the most important are Liverpool,

the seat of Messrs. Muspratt's, and Glasgow, of Messrs. Tennant's works. Accordingly, we find in the "Statistics of the Alkali Trade of the United Kingdom for 1862," that the annual consumption of manganese was then 33,000 tons for the manufactures depending on the products of the alkali trade, viz.: soap, glass, paper, cotton, woollen, linen, colour making, and all chemical manufactures of any magnitude. This estimate, however, takes no account of the ore used in making iron, and the demand for bleaching powder has been increasing of late years, partly owing to the use of grass, and perhaps of other materials, in the making of paper. The quantity of manganese ores used in the United States was, a year ago, estimated by a gentleman dealing in them in Boston, at about 500 tons per annum, by another gentleman, this year, at 1000 tons.

With regard to the quality of the ore required in certain cases, it is found that in making bleaching powder, the ordinary ores, containing perhaps from 65 to 75 per cent. binoxide along with water, oxide of iron, carbonate of lime, barytes, etc., answer so good a purpose, that the rich pure ores, such as that from Teny Cape, are not bought for this use, unless at a price far below that given by those who require only such ores. One of the firm of Tennant Co. (makers of bleaching powder), said, for example, that he could not afford to use Teny Cape ore, meaning, I suppose, at the high price it would fetch from glass makers, for, as J. Outram, Esq. junr., informed me, the Spanish ore of from 70 to 75 per cent. binoxide, sells for fifty-five to sixty shillings sterling per ton, and therefore the bleaching powder makers will give only about £5 10s. for Teny Cape ore, containing upwards of 90 per cent., while, as we have seen, this actually brought as much as £9 and even £10 stg. per ton. This high price was given by glass and pottery makers who require an ore as free as possible of iron; this at any rate is the case with the former who employ it to remove the stain of iron from the finest kinds of glass. Mr. Outram said that he thought even two or three per cent. of iron would interfere with the sale of ore at 93 per cent. binoxide for this purpose, and it was because the Teny Cape ore gave less than a half per cent. of iron, with 91·5 per cent. binoxide of manganese, that it brought the high prices obtained. The demand for these pure rich ores is comparatively

limited, perhaps a few hundred tons a year are fully as much as would find sale at the highest prices named. That there is always a steady demand for ore useful for making bleaching powder, is shown by the efforts made to restore to its original state the oxide employed: patents have been taken out for this purpose, and one is recommended by its owner as restoring the material to 52 per cent. and as being capable of bringing it up to 70 per cent. binoxide, which, as we have seen, is a very moderate percentage in the ores.

With regard to the other applications of manganese, the making of iron and steel is the most important. Manganese renders iron tough and steel better and more durable, in the latter case it acts by removing sulphur and silicon. Although the quantity of manganese actually imparted to the iron and steel is very small, in a manufacture of such enormous proportions the consumption must be large if continued. The making of manganates and per-manganates, which are used as oxidizing agents and in disinfecting, must also be extensive, a prize medal having been given to Mr. Condy in 1862 for the manufacture of such salts on the large scale.

As an illustration of the way in which the ores are sometimes treated in practice, I may mention the mode adopted by Mr. Hobbs, of Boston, who has had a great deal to do with the Upham and Shepody ores of New Brunswick. The ore is washed clean at the mines, boxed up, and sent to Boston, when it is selected into three good qualities and refuse; the three good sorts are ground in three mills till fine as flour, put up in barrels papered inside, and the contents of each barrel are assayed and sold according to assay.

The first quality free (?) of iron and containing about 98 per cent. of peroxide of manganese, is used for making the finest (flint) glass. The second quality (also no doubt pretty free of iron), containing from 75 to 80 per cent. peroxide, is used for making white phials. The third, containing about 70 per cent. peroxide, is employed for making common glass bottles; while the refuse, containing perhaps 25 or 30 per cent. iron, is used either in making clear amber coloured bottles for brandy, etc., or for carboys.

In conclusion I state together the quantities of binoxide of manganese contained in some of the Nova Scotian ores, as found by the experiments of my pupils or myself:—

	per cent. binoxide.
Manganite, from Cheverie, Hants Co., air-dry, gave.....	47·73
Wad, from Halifax Co. (?), dried at 212°, gave.....	56·00
Pyrolusite and Psilomelane } from Douglas, Hants Co., air-dry, gave...	84·62
Pyrolusite, Teny Cape, Hants Co., No. 1, air-dry, gave...	88·01
" " " No. 2, " "	92·69
" " " No. 3, dried at 212°...	95·00
Pyrolusite, from Cumberland Co., dried at 212°, gave....	97.04

These results relate to the most important character of the ores; in the rich samples the amount of iron was generally very small; other analytical details are omitted, as this paper is perhaps long enough already. It is apparent, I think, that the ores of manganese are likely to prove of considerable importance in the economic mineralogy of the Province.

APPENDIX.

ABSTRACT OF METEOROLOGICAL REGISTER, HALIFAX, NOVA SCOTIA, LAT. 44° 39′ 26″ N., LONG. 63° 36′ 40″ W.

1864.	Thermometer.				Barometer.				Winds.		Weather, &c.								
	Max.	Mean.	Min.	Range.	Max.	Mean.	Min.	Range.	Most prevalent.	Least prevalent.	Rain fell on	Snow fell on	Hail fell on	Fog on	Aurora Borealis.	Solar halo on	Lunar halo on	Lightn'g.	Thunder.
											Days	Days	Days	Days	Nights	Days	Nights	Days	Days
January.....	50°	23°	— 4°	54	30·13	29·61	28·96	1·17	N. W.	E.	6	11	...	2	1	...	3	...	...
February..	49	26	— 2	51	30·18	29·81	28·51	1·67	W.	E.	7	9	...	6	2	1	2	...	...
March.....	49	28	13	36	29·86	29·47	28·67	1·19	W.	S.	6	9	2	2	3	3	2	1	1
April.	61	36	18	43	29·96	29·63	29·10	·86	N. E.	S.	11	5	1	1	8	3	...	...	...
May.....	69	48	31	38	30·05	29·64	29·29	·76	S. E.	N.	15	...	...	10	5	2	1	1	1
June...	92	57	37	55	30·06	29·66	29·06	1·00	S. W.	E.	8	...	1	5	3	1	1	1	4
July	83	62	50	33	30·06	29·73	29·52	·54	S. W.	E.	11	...	...	5	1	2	...	3	1
August.....	82	64	48	34	29·99	29·72	29·28	·71	S. W.	E.	13	...	...	12	7	...	1	3	3
September..	72	56	39	33	30·11	29·72	29·13	·98	S. W.	E.	6	...	1	2	10	1	2	3	2
October... .	63	46	29	34	30·22	29·56	29·18	1.04	N.	E.	15	1	2	3	8	2	1	3	2
November..	58	39	21	37	30·22	29·68	29·17	1.05	S. W.	E.	11	2	1	4	5	1	2	...	...
December..	45	27	— 5	50	30·26	29·55	28·48	1.78	N. W.	E.	9	12	...	4	1	...	2	...	...
Yearly..	...	43	...	97	...	29·65	...	1·78	.....	.....	...	...	...	...	...	...	...	...	...

EXTRACT of a letter from Vice-Admiral Sir ALEXANDER MILNE, K. C. B., to the President, concerning the currents on the N. E. coast of America.

"I am much interested in the question of the currents, and during many years that I navigated the coast of Nova Scotia, and between Halifax and Bermuda, had invariably attended to the set of the Gulf Stream. The best information, however, which has been published of its strength, &c. off the coast of the United States, will be found in Blunt's American Coast Pilot, from the survey and report of the Government Surveyors. My own observations extend more to the north, and give the northern limit, or rather a north west limit, of which I will give you an abstract from my notes. I conceive this limit is caused by the deep current coming in contact with the shoals or soundings in some two or three hundred fathoms water extending from the shore of Nova Scotia, after passing over this limit, or from the line of the warm water into the cold, the currents become uncertain, and this is the case all along the coast of Nova Scotia up to the latitude of Scatterie. The other great current is the one from the Polar Regions, along the east coast of Newfoundland, extending down to the latitude of Cape Race, when a western part of it runs round it into the Bay of St. Mary's; but the eastern part becomes lost; it is probably checked by a northern limit of the Gulf Stream and turns it more into a north east direction. In the admiralty there is no single volume specially devoted to these various currents; but in Bayfield's St. Lawrence, and the Nova Scotia Pilot, Rennells' currents, you will find various extracts from the surveyor's report, but the outer currents, that is, those distant from the shore, are but little known. * * *

"I have no doubt that tropical seeds, fish, crustacea, &c., are carried up to northern latitudes and deposited by the Gulf Stream. Very much to my surprise I saw a shoal of flying fish in Lat. 37° 50′ N. Long. 64° 50′ W., the temperature of the water being 73°, air 71°. I never expected to have seen them so far from a West Indian sea, although some few exist at Bermuda of a small size, but those in the Stream were of a larger description of the West Indian fish. They were very lively and rose in numbers. There is no record of soundings on the north edge of the Gulf Stream, and I cannot find that any sand &c. has ever been brought up by the lead; no doubt it would be an interesting source of investigation, but I see no prospect of its ever being carried out by government, unless a special surveying vessel was employed to trace the line of sounding from the eastward of Sable Island round to the St. George's Shoals."

"P. S.—The mean northern limit of the Gulf Stream between Halifax and Bermuda from fourteen voyages was found to be in Lat. 40° 56′ N., Long. 63° 45′ W."

FIELD EXCURSION, 1865.

THE Institute held a Field Day at the Waverly Gold Mines, on Saturday the 1st July.

The members assembled at the Steamboat wharf, Dartmouth, where carriages waited to convey them to the Mines, about twelve miles distant.

The village of Waverly is one of those new places in Nova Scotia, which owe their existence to the discovery of gold. It comprises a cluster of houses at the head of Lake William, which is there connected with Lake Thomas by a drawbridge; there are also a number of scattered dwellings and shanties in the vicinity of the various shafts, and within a circuit of about five miles. The country around is hilly and rocky, wild and desolate, much broken by mining operations, the debris of which is seen on all sides, and especially where shafts have been sunk, or excavations made. The scenery, however, has some redeeming features. It has all the components of natural beauty, and is rich in hill and valley, wood and water. It is also recommended by the charm of novelty; and is besides a prolific study to the geologist and botanist, and to naturalists generally.

The party first visited the "barrel quartz," so called, a few rods east of the village, near the summit of Laidlaw's hill. Let the reader suppose a series of trunks of willow trees some eighteen inches in diameter, unstripped of bark, laid side by side, close to but independent of each other, and he will have some idea of the appearance which the "barrel quartz" formation would present if fairly exposed; but the barrels or trunks are pure quartz, encased in "whin" rock, which is a highly indurated quartzite, and very different in appearance from the clay slate walls which in general enclose the quartz found in other districts. When first worked the "barrels" proved rich in gold, and led to much speculation, the hopes of which have not been realized, and the work is for the present suspended.

Various opinions have been hazarded as to the origin of this curious formation. It has been thought to be the summit of an anticlinal which has been greatly eroded and denuded of the overlying rock. There is ground for the supposition, inasmuch as the rock covering the quartz is plainly marked with glacial striæ which follow the usual N. W. and S. E. course, a fact which proves also, that here as well as every other part of Nova Scotia, there has been no geological change since the glacial era. Others suppose the quartz to have been deposited from super-silicated rocks, acted upon by chemical solvents. The containing rock, named "whin" by the miners, is of a grey colour inclining to light blue, and is usually compact and hard. The igneous theory is also brought to bear upon this peculiar formation; and hypotheses in connection therewith are hazarded, in an excellent paper by Colonel SINCLAIR, which was read in the afternoon, and will be found in its proper place further on.

Several shafts were visited. At one a ventilator was in use, the air in the pit being impure. The Taylor Company had sunk a shaft 150 feet, from which much valuable quartz had been extracted, and had then driven a con-

siderable distance to Mud Lake, underneath and across which they were preparing to tunnel.

Returning a short distance, and then proceeding onward southward of this small lake, by a road passable with care for a carriage, the shafts sunk by the German Companies, (so called,) and successfully worked, are seen. This part of the village of Waverly has been named Germantown; and some distance further on, the building containing the Crushers, and other processes for extracting the gold, come into view. The superintendent of this establishment, L. BURKNER, Esq., and another gentleman connected therewith, very obligingly accompanied the party, and explained practically the various processes of crushing the quartz and washing it, and amalgamating and retorting the gold. A large quantity of quartz, in lumps weighing from one to thirty pounds, in nearly all of which gold was conspicuous, lay around, ready for the crushers. The quartz then being worked was white, but with a perceptible and peculiar blush tinge. It occurs in veins of six inches thick, more or less, the gold disseminated throughout in small grains, which the miners designate as "sights." Galena frequently occurs in the quartz, and it has been remarked here, that the gold appears to be more plentiful when in contact with it. This was said to be contrary to the experience at Hammond Plains, a few miles west of this locality, where zinc blende is more prevalent, and with reference to the yield of gold appeared to take the place of the galena. Mr. BURKNER, in the most courteous manner, selected a handsome specimen of auriferous quartz from the heap, and presented it to the President for the Museum of the Institute. There were sixteen stampers at work, and more were to be added. The party were hardly prepared for the extensive operations they witnessed, and were deeply impressed with the industrial occupation of gold mining, and its importance as an aid to the progress of the country. It is chiefly from the works of this Company that every now and then an ingot of pure gold, as large and thick as a stock brick, delights the eyes of the people of Halifax, and convinces them that Nova Scotia is able to maintain its place among the gold producing regions of the earth. The last ingot brought into Halifax, was worth $80,000 and was the product of a month's labour of the operatives of the Company.

After resting awhile at the office of the obliging superintendent, the party left the Mines, and were conveyed to Marshall's Inn, where they sat down, in number fourteen, to a substantial repast. When this had been fairly discussed, the President called upon the Members present to communicate the result of their observations, and an interesting desultory conversation ensued. The Secretary then asked permission to read a paper entrusted to him by Colonel SINCLAIR, a member of the Institute, who had been unable to attend, on the subject of the "barrel quartz" formation, before alluded to, which is as follows:—

THE CONTORTED QUARTZ LODE AT LAIDLAW'S "DIGGINS," WAVERLY.

THIS extraordinary quartz lode conclusively proves that it and similar formations were once in a molten and plastic state.

This has been, exceptionally, controverted; it has been held that the mineral seams, variously denominated according to their thickness, were originally cracks, subsequently filled by a process of deposition, for which present experience and hypothetical science fail satisfactorily to account.

The lode in question conclusively prostrates Mr. Evan Hopkin's theory that auriferous quartz *in situ*, and its contained gold, is the result of electrical action, or that in common with magnetic agency.

Remote hypothesis may postulate as an objection, rather than really conceive, that the electrical or magnetic formation of the Laidlaw lode may have been antecedent to its plastic state.

But no one would credit or advocate such a notion unless he were intent on establishing a favourite theory.

Natural philosophers have natural feelings; no one likes to be wrong in a matter to which he is committed in writing.

Quartz is crystalline, sometimes perfectly so, in common with volcanic obsidian, and factitious glass, which it resembles. It is a flux of silica more pure than glass or obsidian, which contain more alkaline fluxes, such as lime, potash and soda; but auriferous quartz, imperfectly crystallized, invariably contains iron, which can be drawn from the pulverized mineral with a magnet.

The arrangement of crystalline particles is an illustration of a certain kind of attraction; but this attraction or affinity resides in the substance itself; it is only analogous to magnetic attraction; it has no peculiar sympathy with external polar influence; it seems to have far more connection with chemical affinity than atmospheric or terrestrial electricity.

Were crystallization more than merely analogous to polar magnetism, in the formation of ice we should observe that the arrangement of successive atoms would follow or pursue some particular direction, but it is not the case; the acicular radiations from the point first congealed shoot out in *all* directions, and by interweaving eventually form a solid uniform mass of equal thickness;—a lake or pond, does not as a rule, freeze from one quarter of the compass to another.

Still less can electricity or magnetism account for the presence of metals in ores; rare specimens of crystallized gold have been produced in nature—in art crystals are produced by allowing substances to take their own form after fusion or solution, and electricity, to produce the same result, must either fuse or solve.

If by this or other means electricity can accelerate the formation of a crystal, it is merely as a local laboratory agent that it acts; its use and action in this respect as a natural agent, has neither been traced nor proved.

An attempt to account for the presence of gold in the lode, seems to be fraught with the same difficulties which would attend a similar investigation with respect to other metals, and the minerals with which they are usually associated.

Most of them have affinities in themselves, and with one another. The peculiar affinity which quartz has with gold has never been displayed or explained

—but until experiment and observation can very clearly establish the contrary, we must be content to assume that there is some affinity between them *in se*,—and if there be any peculiar operative external agency instrumental in associating them, it is rather an agent than a prime cause.

The presence of the metal and the material for its matrix, in a certain degree of proximity, must be pre-supposed as a normal condition — fusion by heat as a prime cause of the arrangement of mineral lodes; at any rate until we are in a position to establish a better theory, we must accept this.

Silica, the base of quartz, pure or impure, is the most universally distributed mineral; it enters into fully two-thirds of the earthy minerals known.

Gold can be extracted by the expert chemist, tending to show that in very minute proportions it is as universally present as iron or the commoner metals —the analysis has been carried to such an extent, that it is alleged to have been found in a flower!

So that in nearly every metamorphic fusion which has taken place, silica and gold must have participated.

Where the subsequent crystalline arrangement on cooling has resulted in the formation of paying lodes, veins or seams of any metal useful in the arts, it is natural to conclude the pre-existence of the metal contained in unusual local proportions.

Notwithstanding the obvious simplicity of this theory, which really more resembles a natural postulate than a hypothesis, the Barrel lode at Laidlaw's is valuable evidence confirmatory of a once controverted question which it is eminently calculated to set at rest, so much so, that it is hardly to be regretted if its bad yield has saved it from entire destruction.

It is evident that when in a true plastic state contortion took place, which could not have resulted had the quartz been in either a solid or a perfectly fluid state.

The lode is, or was, nearly horizontal, had very little dip, its contortions may have been partly attributable to the nature of the ground, but I dont think so; I believe the whole, killas and all, were in a state of fusion flowing against an obstacle at a lower level, the lower portion becoming stiffer from cooling, whilst the succeeding on-flow of a less viscid mass overlapped and cooled in its turn.

The contortions were very singular from their regularity; when the backs were bared they presented an appearance aptly described as resembling trunks of trees laid from two to four feet apart, parallel to one another; the undulations were so remarkable, that it is questionable whether any other mineral lode has ever been found of a similar character, and it is worth notice—perhaps record.

Irrespective of scientific value, a report on this lode may be of practical use, for in shafting to intercept a known lode, in a contorted "country," unless bends be observed, in mining on a large scale calculations may be a very great number of fathoms out on the wrong side of the estimate, causing serious additional expense and delay.

As according to Mr. Campbell's opinion, as I understand it in his first

report, the whole metamorphic series of the Province consists of a number of anticlinal axes, caused by the protrusion of granite, with more or less contorted killas, or slate and bluestone, with quartz lodes between the axes, the matter is not unworthy of attention in an economic point of view.

R. B S.

Conversation ensued upon the subject matter, which was all the more interesting, that the formation alluded to had just come under the observation of gentlemen present. The thanks of the meeting were then voted to Colonel SINCLAIR for his excellent Paper.

The party soon afterward returned to Dartmouth, and crossed to the city, highly pleased with their excursion. W. G.

LETTER from the Right Rev. THE BISHOP OF NEWFOUNDLAND, concerning the Mummy of the Great Auk, (*Alca impennis*,) found on the Funk Islands.

"ST. JOHN'S, N. F., Aug. 10, 1864.

"*My Dear Sir*,—

"I am much pleased that the mummy arrived in a good state of preservation. How long it has been embalmed or entombed in the ice I cannot of course tell, but I understand the different specimens were found several feet (at least four) below the surface, and under ice which never melts. They were all found on the Funk Islands, but on which side I am not able now to discover, as the person who dug them up is not at present, I believe, in St. John's. He was sent, or went there to gather the guano or bird manure on speculation, with strict injunctions to procure, if possible, the bones, or skeletons, of the extinct bird. In this he succeeded better than in his own business, and probably if he had known the value attached to these specimens by naturalists he might have turned them to better account than the guano. One specimen I sent to Mr. Newton, and you saw by his letter how highly it was prized. Another was sent to Agassiz, and the third I have been enabled through the kindness of our Governor to forward to you. And this is the most perfect of the three, or certainly more perfect than the one I sent to Mr. Newton,—the other I did not see.

"I think it very likely more specimens might be found, as no persons are living on the island, and it is only lately that any attempt has been made to discover and preserve the skeleton.

"Yours faithfully,

"ED. NEWFOUNDLAND."

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

PATRON—His Excellency the LIEUTENANT GOVERNOR.

COUNCIL, 1865.

J. M. JONES, Esq., F. L. S., *President.*
Capt. HARDY, R. A., } *Vice Presidents.*
Dr. J. BERNARD GILPIN, M. D., M. R. C. S., } *Vice Presidents.*
Capt. LYTTLETON, *Treasurer.*
WILLIAM GOSSIP, Esq., *Secretary.*

Dr. DEWOLFE, M. D.
Prof. LAWSON, Dalhousie College,
Colonel MYERS,
W. C. SILVER, Esq.

J. H. DUVAR, Esq.
P. S. HAMILTON, Esq.
JOSEPH BELL, Esq.
Lieut. DEANE, 17th Regt.

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

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

Rev. A. F. Kenelly
with D. Honeyman's
kind regards

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science

OF

HALIFAX, NOVA SCOTIA.

VOL. I. 1865-6. PART IV.

CONTENTS.

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OF THE

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FOR

1863, 1864, 1865, 1866.

VOLUME I.

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1867.

ERRATA.—For "Vol. II." printed on each of the two preceding parts of the Transactions, *read* Vol. I. The present part completes Vol. I.

PROCEEDINGS

OF THE

Nova-Scotian Institute of Natural Science.

VOLUME I. PART 4.

Anniversary Meeting, Oct. 9, 1865.

In accordance with the Bye-Laws of the Institute, the Anniversary Meeting, was held on Wednesday, Oct. 9, 1865, at 8 p.m. when the following gentlemen were elected office bearers for the ensuing year :—

President.—J. M. Jones, F. L. S.

Vice-Presidents.—J. B. Gilpin, M.D., Lt. Col. C. Hardy, R. A.

Treasurer.—Capt. Lyttleton.

Secretary.—Wm. Gossip.

Council.—Colonel W. J. Myers, F. R. M. S., J. R. DeWolfe, M. D., *Edin.*, Professor Lawson, L. L. D., Jos. Bell, J. H. Duvar, P. S. Hamilton, W. C. Silver, Lt. Col. Clifford, Royal Artillery.

The President in a brief address regretted that the state of the weather had prevented a larger attendance. He entered upon various topics connected with the welfare of the Institute, and alluded especially to the difficulty that had been experienced in carrying out the intentions of the Institute with reference to the summer Field Meetings, which he considered useful, not only in attracting attention to the natural products of the localities visited, but also in engendering a taste for enquiry into matters pertaining to the physical history of the Province. The Chief Commissioner of Railways had very kindly offered free passage over the lines to members attending Field Meetings, and every inducement was therefore offered to those who desired to participate in such meetings ; but he was very sorry to say that but a very small proportion of the members took part in these excursions.

The Treasurer's account was examined and found correct, showing a balance credit of $81.87½.

Ordinary Meeting, Nov. 6, 1865.

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

Dr. J. B. Gilpin read a paper on the Mackerel (*Scomber vernalis*, Mitch.)

illustrated with coloured drawings of two varieties of that species. (*See Transactions.*)

During the conversation that ensued, it was stated that the Mackerel was a much more valuable fish than the herring for commercial purposes. They did not taint so quick when in bulk. The present method of salting was described by Capt. W. T. TOWNSEND. It appeared to differ from that formerly practised, the fish being now packed with the back *upwards*, which prevented the saline sediment sinking into the flesh. A different species or variety of *Scomber*, which came upon the coast about eighteen years ago, none of which had been seen of late years, was alluded to. The upper jaw at the point was curved over the lower, and the fish was much larger and fatter than those now taken. Formerly in the spring the mackerel were all small, and in autumn all large, now they always varied in size at all seasons, large and small ran together.

With reference to the mackerel hybernating in shore mud during winter, the PRESIDENT mentioned a curious circumstance which had come to his knowledge, where a fisherman of Prospect Harbour, had taken one of these fish while eel-spearing through the ice of the harbour, the eyes of which were covered with a thick film. He considered that the supply of the fish on our shores depended very much on that of their particular food, which, if not abundant in the localities generally visited by them, would be sought for and found in other places, causing failure to the fisheries in some parts, while unprecedented luck would be had in others.

Capt. TOWNSEND also stated that the mackerel appeared very regularly on the Atlantic coast, nearly to a day, viz. on the 26th May. They were frequent around the Magdalen Islands all summer, and were found further north, even as far as the north-west coast of Newfoundland, but they had not been seen on the east coast for twenty-one years.

The PRESIDENT read a paper—"On the Geological Features of the Bermudas."—(*See Transactions.*)

In the discussion which ensued, the probability of those Islands having been once connected with the mainland, was mentioned by a member.

EXTRAORDINARY MEETING, NOV. 16, 1865.

The members met pursuant to notice, in the room at the Province Building, and proceeded to Government House to wait upon His Excellency Sir F. W. WILLIAMS, Bart., (of Kars,) the Lieut. Governor, who had graciously assented to the request of the Council of the Institute that he would become its Patron, vice Sir R. G. MAC DONNELL, the late Governor.

On being received by His Excellency, the PRESIDENT stated that owing to a rule of the Bye-Laws, all Lieut. Governors of the Province were to be requested to become Patrons of the Institute during their tenure of office, and that the Society would gladly enrol His Excellency's name in the place of his predecessor, expressing a hope that His Excellency would give his countenance and encouragement to their proceedings for the advancement of science and the benefit of the country.

His EXCELLENCY in reply said it would give him great pleasure to become the Patron of an Institution that was doing so much good in the Province, and that he would endeavour to further its objects as far as lay in his power.

ORDINARY MEETING, DEC. 4, 1866.

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

RIGBY WASON, Esq., 16th Regt., and Lieut. ANDERSON, Royal Artillery, were elected members at the previous Council Meeting.

The SECRETARY read a paper by Lieut. Col. R. B. SINCLAIR, A.G.M. "*On Pisciculture,*" (*See Transactions.*)

The PRESIDENT read a paper by Mr. ELIAS MARETT, Associate Member, of St. John's, Newfoundland, "*On Bone and other Implements found in a Cairn of stones which covered the remains of a Bœothick or Red Indian, on an island of the Lower Burgeo group, Newfoundland.*" (*See Appendix.*)

The paper was illustrated by carefully drawn *fac similes* of the relics, from which it appeared that the aborigines who possessed them must have had some knowledge of the christian religion, or of its observance, and also of modern weapons of warfare, for on some of the implements were depicted rude crosses and cutlasses.

From the remarks made by several members it appeared that the Red or Copper Indians of Newfoundland, were sometimes met with as late as the year 1819. On March 5th, of that year, a Mr. Peyton, who carried on considerable salmon fisheries at the north of the island, having for some years been greatly annoyed and having suffered extensive injury at the hands of these natives, determined to go into the interior to have a meeting with the tribe, to endeavour to commence their civilization; but the expedition ended disastrously, for one of the Indians, at the first meeting having seized Mr. Peyton's father with the intention of killing him, was shot, and the rest ran away, with the exception of a woman who was brought back to St. John's, and became civilized, but her death occurred soon after on Jan. 8, 1820. In the spring of 1823, a fur hunter and his companions fell in with an Indian man and an old woman. The former fled, but the other approached and joined the party, whom she led to a place where her two daughters were. One was about 20, the other 18 years of age. The women were brought to St. John's, but the daughters being attacked with consumptive symptoms, were hurried back into the interior. The mother lived for some years at St. John's, dying at last of consumption. Nothing appeared to have been heard of this singular race from that date.

J. B. GILPIN, M. D., *Vice President*, read a paper on *Salmo Gloverii*, called by the country people *Grayling*. (*See Transactions.*)

An excellent coloured drawing of the fish accompanied the paper, and sketches of other members of the *Salmonidæ* were also exhibited.

In the conversation which ensued, it was stated that an eminent authority had given as his opinion that the Nova Scotian *S. fontinalis* was a char. Dr. Gilpin believed that *fontinalis* went down to the sea and returned. The

remarks of different members, however, only tended to prove that the *Salmonidæ* of the Province required more attention at the hands of ichthyologists.

The President, on behalf of the members, thanked the Lord Bishop of Newfoundland, Dr. FIELD, (who was present as a visitor,) for his kindness in forwarding a specimen of the Great Auk (*Alca impennis*,) from Newfoundland, which had enabled them to become acquainted with the anatomy of a bird which was now extinct.

His Lordship in reply stated that he was glad to find that the specimen in question had proved interesting to the members. It had been taken with two others from a guano bed on one of the Funk Islands, lying off the N. E. coast of Newfoundland, and was by far the most perfect of the three. He should always be happy to render any assistance in his power to further the object of the Institute, in gaining a knowledge of the Natural History of Newfoundland.

ORDINARY MEETING, JAN. 8, 1866.

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

The Rev. JOHN MORTON, Bridgewater, was elected an Associate member at the previous Council Meeting.

Professor JAS. DEMILL, Dalhousie College, and J. RUTHERFORD, were elected members at the previous Council Meeting.

The Rev. JOHN AMBROSE read a paper entitled, "*Observations on the Fishes and Fishing Grounds of St. Margaret's Bay.*" (*See Transactions.*)

In connection with the observations of Mr. Ambrose, Capt. HARDY mentioned a curious circumstance which occurred last summer. A friend who was fishing in the North West Arm, hooked a hake (*Merlucius vulgaris*), and bringing it to the surface it was gaffed by a companion. The gaff, however, broke off at the socket, and the fish made its escape with the instrument sticking in it. After a short time they commenced fishing again, and hooked and gaffed a second time securely, the very same hake with the old gaff fast in its back.

The PRESIDENT read some "*Notes on Hurricanes and Revolving Gales of the North Atlantic,*" by J. S. HURDIS, of Southampton, England. (*See Appendix.*)

Capt. W. T. TOWNSEND stated his recollections of the Bermuda Hurricane of 1839, he having been on board a vessel off the coast of Newfoundland at the time when the gale reached that latitude. He described the unusual violence which characterized it, and the quarter from which it came, which differed from that of more southern points on its route.

Mr. R. MORROW exhibited some very curious rounded masses of vegetable origin, which he had procured from the shores of a lake in the forest some distance to the eastward of Halifax, and which had puzzled the minds of several naturalists, as to their method of formation.

Mr. C. FAIRBANKS, by request, laid upon the table a fine series of celts, spear and arrow heads, and several weapons and ornaments which he had procured in different parts of the colony.

ORDINARY MEETING, FEB. 5, 1866.

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

Messrs. J. R. MILLER, JAMES FORMAN, JAMES B. MORROW, and JOHN KELLY, were elected members, and Mr. J. L. HURDIS, of Southampton, England, a corresponding member, at the previous Council Meeting.

Mr. P. S. HAMILTON, Chief Commissioner of Mines, read a paper "*On Auriferous Deposits in Nova Scotia.*"

Professor LAWSON made some remarks upon the different methods at present practised in the crushing of gold quartz.

Capt. W. T. TOWNSEND exhibited a very curiously formed "nugget" of large size in the form of a cross, which had been obtained at one of the mines.

The PRESIDENT read a continuation of Mr. J. L. HURDIS'S "*Notes, on Hurricanes and Revolving Gales of the North Atlantic.*" After its conclusion he called attention to the almost perfect calm which had prevailed at Halifax during the last month or two, when the Atlantic, at a distance of a few hundred miles, had been the theatre of a series of storms of unparalleled violence. He considered that as the Gulf Stream was undoubtedly the great course over which the tropical gales swept their way, those gales were to some extent influenced by the colder atmosphere which rested over the course of the cold ocean current, which at that season of the year came with additional force from the north, filling the intervening space between the western confine of the gulf stream and the shores of Nova Scotia. This cold atmosphere might act as a barrier against the westerly extension of such tropical storms, and turn them in an easterly or north-easterly direction, which would point them to the shores of Europe. He contended that the currents of the ocean might have more influence upon the course of storms than was generally imagined, and considered that it only required time and a proper system of observation to prove the supposition.

Vice President GILPIN read a short paper describing a species of *Blarina*, recently taken near Halifax, which appeared to be entirely new to the Nova Scotian fauna.

ORDINARY MEETING, MARCH 5. 1866.

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

Colonel W. J. MYERS, read a paper entitled "*Notes on the Weather during* 1865." (*See Transactions.*)

The President read a paper by Professor HOW, of King's College, Windsor, "*Notes on the Economic Mineralogy of Nova Scotia;—Limestones and Marbles.*" (*See Transactions.*)

The Commissioner of Mines made some observations relative to the white marble that had been noticed in the paper, which was stated to have been full of flaws. He happened a short time ago to be at the quarry, and heard from a person there that the parties who had been at work had actually blasted the marble with gunpowder. He thought this, without reference to other causes, might well account for the shattered state of the specimen taken to England.

At a short distance from this quarry another kind of marble occurred, which came as near to the description of *verd antique* as he considered possible. These marbles were not more than two miles from a shipping place.*

The Secretary read a paper by the Rev. JOHN MORTON, of Bridgewater, entitled—"*Remarks on the Pitch Lake of Trinidad.*" (*See Transactions.*)

Colonel MYERS and Mr. F. WAINWRIGHT, who had resided on the island, gave some interesting descriptions of its natural history.

Capt. LYTTLETON gave an interesting verbal account of his recent visit to the Oil Springs of Canada, and referred to their great commercial value.

ORDINARY MEETING, APRIL 2, 1866.

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

Professor LAWSON, Dalhousie College, read a paper—"*On Sodium as an Amalgam,*" accompanied with interesting experiments. (*See Transactions.*)

The Hon. the ATTORNEY GENERAL had his attention called to the metal when in England lately, where he had visited the laboratory of Mr. Crooks, and had witnessed a series of experiments by that gentleman, having for their object its introduction into gold producing countries. He deemed the experiments quite conclusive and satisfactory, and they were such as Dr. Lawson had exhibited before them that evening.

Dr. DEWOLFE alluded to a communication which had been published by Mr. THOS. BELT upon the same subject. Mr. Belt's design was to procure a patent for a mode he had discovered of applying sodium as a flux of gold. He thought it would be well to ascertain if Mr. Belt's patent was in existence, and also its merits in comparison with the other process.

Capt. HARDY, R. A., (*Vice-President*) made some observations on the chlorides as disinfectants and their mode of preparation.

Vice President GILPIN read a paper "*On the Food Fishes of Nova Scotia.*" (*See Transactions.*)

The PRESIDENT referred to the identity of species in regard to several marine fishes of N. E. America, and N. Europe, and instanced the Cod, Mackerel, Herring and others, as presenting no marked difference from those of the British coast.

Professor LAWSON remarked that the White Fish mentioned in Dr. Gilpin's paper he had always considered peculiar to the large Canadian lakes. Dr. GILPIN, in reply said they were frequent in the rivers of New Brunswick, especially in the Madawaska, and were also taken in Lake Temisquata.

ORDINARY MEETING, MAY 8, 1866.

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

The Secretary read a paper by THOS. BELT, F. G. S.,—"*On the Glacial Period in Nova Scotia.*"—(*See Transactions.*)

Rev. Dr. HONEYMAN, F. G. S., read a paper—"*On the Geology of Antigo-*

*It is the intention of the Nova Scotian Commissioners to send a fine series of these marbles to the Paris Exhibition of 1867.

nish."—(*See Transactions.*) The paper was accompanied by a carefully executed geological map of the district.

Lieut. Col. HARDY read a paper—"*On Nova Scotian Coniferæ.*" (*See Transactions.*)

A series of photographs illustrating each species exhibited the foliage in minute detail.

Mr. ANDREW DOWNS read a paper on—"*The Birds of Nova Scotia.*" (*See Transactions.*)

DONATIONS TO THE LIBRARY.

Nov. 20, 1865, to Aug. 31, 1866.

IN EXCHANGE.

Boston.—Proceedings of the Boston Society of Natural History, Sept. and Oct. 1865. 1866, pp. 49-80. 81-144. 145-176. 177-224. 225-288. 289-320. 321-352.

Dumfries.—Transactions and Proceedings of the Dumfries and Galloway Natural History and Antiquarian Society, Session, 1863-4.

Montreal.—Canadian Naturalist, 1864, Feb.; 1865, April, June; 1866, Feb.

New York.—Annals of the Lyceum of Natural History, vol. 8; Nos. 6, 7, 8, 9, and 10.

Philadelphia.—Journal of the Franklin Institute, 3d series; vol. 50, Nos. 5 and 6: vol. 51, Nos. 1, 2, 3, 4, 5 and 6: vol. 52, Nos. 1 and 2.

Salem.—Proceedings of the Essex Institute, 1865, July, Aug., Sept., Oct., Nov. and Dec.: 1866, Jan., Feb., March.

Toronto.—Canadian Journal, 1865, Nov.: 1866, Jan., April.

PRESENTED.

Condition and Doings of the Boston Society of Natural History, May, 1865. *The Society.*

Result of Observations on the Drift Phenomena of Labrador, by A. S. Packard, jr., M. D. *The Author.*

Hints on Meteorology, with summaries of observations made at St. John, New Brunswick, between the years 1850 and 1862, by G. Murdoch. *The Author.*

Preliminary Report on the Geology of New Brunswick, by H. T. Hind. *Natural History Society of New Brunswick.*

Observational Astronomy and Guide to the use of the Telescope, by J. T. Slugg. Physical Geography of the Sea, by Lieut. Maury. A Geographical and Comparative List of the Birds of Europe and North America, by C. S Buonaparte. Handbook of the Law of Storms, by W. R. Birt. *Lieut. Col. Austen*, Jersey.

Historical Notice of the Essex Institute. *The Institute*

The Gold of Nova Scotia. Description of the Remains of a New Enaliosaurian from the coal formation of Nova Scotia. Catalogue of Mineral localities in New Brunswick, Nova Scotia and Newfoundland. On the Science of the International Exhibition. Description of an Ancient Sepulchral Mound, near Newark, Ohio, by O. C. Marsh, M. A., F. G. S. *The Author.*

On Fucoides in the Coal Formation, by Leo Lesquereux. *The Author.*

Erster Jahresbericht des naturwissen schaftlichen Vereines zu Bremen. Fur das Gesellschafts jahr vom Nov., 1864 bis ende Marz, 1866. *Smithsonian Institute.*

LIST OF MEMBERS.

Date of Admission.		
1863.	June 24.	Almon, Hon. M. B., Hollis Street, Halifax.
1865.	Dec. 7.	Anderson, Lieut. Archd., Royal Artillery, Artillery Park.
1864.	April 3.	Bell, Joseph, Granville Street, Halifax.
1863.	Jan. 8.	Belt, Thomas, F. G. S., Newcastle on Tyne, England.
1864.	Oct. 12.	Brown, C. E. Granville Street, Halifax.
1865.	Oct. 6.	Chambers, A. P., Argyle Street, Halifax.
1865.	Aug. 25.	Clifford, Lieut. Col., Royal Artillery, Artillery Park.
1863.	May 13.	Cramp, Rev. J. M., D. D., *President of Acadia College*, Wolfville.
1866.	May 4.	De Mill, James, M. A., *Professor of Modern Languages*, Dalhousie College, Halifax.
1863.	Oct. 26.	De Wolfe, James R., M. D., Edin., L. R. C. S. E., *President of the Medical Society of Nova Scotia*, Dartmouth.
1863.	Dec. 7.	Downs, Andrew, *Cor. Mem. Zool. Soc., London*, Walton Cottage, North-west Arm.
1863.	Feb. 2.	Duvar, J. Hunter, Bedford Row, Halifax.
1864.	Oct. 26.	Finnie, A. S., Bank of B. N. A., Hollis Street, Halifax.
1865.	Oct. 4.	Fleming, Sandford, C. E., *Chief Engineer of Railways*, Halifax.
1866.	Feb. 1.	Forman, James, Bank of Nova Scotia, Halifax.
1863.	Jan. 24.	Fraser, R. G., Spring Garden Road, Halifax.
1863.	Jan. 5.	Gilpin, J. Bernard, M. D., M. R. C. S., Barrington Street, Halifax, VICE-PRESIDENT.
1863.	June 15.	Gilpin, Rev. Canon, D. D., Spring Garden Road, Halifax.
1863.	Feb. 2.	Gossip, William, Granville Street, Halifax, SECRETARY.
1863.	June 30.	Gray, Hon. S. Brownlow, *Attorney General*, Bermuda.
1863.	Jan. 26.	Haliburton, R. G., F. S. A., Barrington Street, Halifax.
1863.	Oct. 26.	Hamilton, P. S. *Chief Commissioner of Mines*, Province Building,
1863.	Jan. 26.	Hardy, Lieut. Col. Royal Artillery, Artillery Park, VICE-PRESIDENT.
1863.	June 27.	Hill, P. Carteret, D. C. L., Morris Street, Halifax.
1863.	Mar. 11.	How, Henry, D. C. L., *Professor of Chemistry and Natural History*. King's College, Windsor.
1863.	Jan. 5.	Jones, J. Matthew, F. L. S., Ashbourne, near Halifax, PRESIDENT.
1866.	Feb. 1.	Kelly, John, *Deputy Commissioner of Mines*, Province Building.
1864.	Oct. 12.	King, Capt. J. R., Royal Artillery, Artillery Park.
1864.	Mar. 7.	Lawson, George, PH. D., LL. D., *Professor of Chemistry and Mineralogy*, Dalhousie College, Halifax.
1865.	Nov. 9.	Lordly, E. J., George Street, Halifax.
1863.	Jan. 8.	Lyttleton, Capt., Hollis Street, Halifax, TREASURER.
1866.	Feb. 3.	Morrow, James B., Brunswick Street, Halifax.
1863.	Jan. 19.	Myers, Col. W. J., F. R. M. S., Dresden Row, Halifax.
1865.	Nov. 17.	Nash, J. D., Dresden Row, Halifax.
1865.	Aug. 29.	NOVA SCOTIA, The Right Rev. Hibbert Binney, D. D., Lord Bishop of
1863.	Jan. 5.	Poole, Henry, Glace Bay, Cape Breton.

1866.	July 28.	Reeks, Henry, F. L. S., Hampshire, England.
1866.	Jan. 8.	Rutherford, John, *Inspector of Mines*, Nova Scotia.
1864.	Mar. 7.	Silver, W. C., Hollis Street, Halifax.
1865.	Jan. 9.	Sinclair, Lt. . ColR. B., A. G. M., Dartmouth.
1865.	April 20.	Smithers, George, Granville Street, Halifax.
1866.	Feb. 1.	Townsend, W. T. Argyle Street, Halifax.
1864.	Dec. 5.	Webber, Lieut. H. H., Royal Artillery, Artillery Park.
1864.	June 1.	Whytal, John, North Wste Arm, near Halifax.
1863.	April 16.	Willis, J. R., *Cor. Mem. Bos. Nat. His. Soc.*, et *Liverp. Micros Soc.* National School, Halifax.
1866.	Mar. 15.	Young, Hon. William, Chief Justice of Nova Scotia.

ASSOCIATE MEMBERS.

1863.	Oct. 26.	Ambrose. Rev. John, M. A., the Rectory, St. Margaret's Bay.
1864.	July 1.	Marett, Elias, St. John's, Newfoundland.
1865.	Dec. 28.	Morton, Rev. John, Bridgewater.

CORRESPONDING MEMBER.

1866.	Feb. 5.	Hurdis, J. L., Southampton, England.

J. M. J.

TRANSACTIONS

OF THE

Nova-Scotian Institute of Natural Science.

Art. 1. On the Food Fishes of Nova Scotia. By J Bernard Gilpin, A.B., M.D.., M.R.C.S.

No. III.

(*Read November 6th*, 1865.)

The Mackerel.

Scomber—Scomber—(*Gunther, Catalogue B. Museum.*)
Scomber—Vernalis—(*Dekay, Storer.*)
Scomber—Grex—(*Mitchell.*)

Dr. Gunther, from actual comparison of English and American specimens, considers them identical. The American authorities consider them different. Dr. Gill, Smithsonian Institute, 1865, gives as typical "finlets, 5—6." This is not true as regards any Scomber I have identified in Nova Scotia as *Vernalis* or *Grex*, and must refer to some southern species.

In my two former papers, I have endeavoured to give to the Society all the facts I could collect, relating to the common Herring and to the Gaspereaux, and their habits. I shall this evening, still following up the subject, read a paper upon the Mackerel. Thus in time we shall have the natural history of all what I may term the Food Fish of Nova Scotia. A true knowledge of the nature, habits, food, spawning time, and localities of our fish, has been a long *desideratum* in our Province, as the success of our fisheries must be based upon it.

The description of a fresh Mackerel, bought in the Halifax fish market on the 27th October, 1865, is as follows :—

Length 17 inches; girth in front first dorsal 7½ inches, head one-fourth of body to root of tail, diameter of eye five-eighths of an inch, about two diameters from tip of nose. As the fish lies dead, a membrane from the posterior part of the orbit half closes the eye. The lines of the opercle and preopercle are nearly at right angles with the line of body the margins of sub and interopercle like a V, with its apex pointing for-

ward, the gill rays are entirely covered by the lower edge of the opercle, and the upper labials concealed within the jaw. Very minute teeth upon upper and lower labials, and in this specimen on palatine arch, though wanting in others.

The shape of the fish is long for its breadth, and very round, tapering gradually to the root of a very small deeply cleft tail. Two dorsal fins, the rays of the first hard, and five finlets, adorn the back. The pectoral fins commencing one-third of an inch from opercle, and ventral opposite posterior edge of pectoral, anal opposite anterior insertion of second dorsal, with sharp ray or prick in front, and fine finlets below. Two fleshy keel-like processes nearly parellel, are on either side of the root of the tail. Both caudal and all the fins are very small for the size of the body. Colour—top of head and ridge along the back, dark blue; sides, to an inch below the lateral line, when just from the water a deep green with about 27 to 30 deep blue horizontal zig-zag bars or stripes from opercles to tail; a little below the lateral line a number of indefinite dark spots or lines, extending from pectoral fin nearly to tail, below yellowish white, with opalescent reflections; tips of both jaws black, tongue and inside mouth black, cheeks green above, yellowish white below, with pink and opal reflections, and covered with numerous purple spots; sides silvery; fins, dorsals and finlets dusky, rays showing black; caudal greenish dusky, base and tips dark; pectoral dusky, base dark; ventral tips dusky with reddish tinge; anal white with a reddish tinge; and finlets below white. These colours are very fleeting, the green turning to blue on the sides very soon; scales very minute, gill-ray 5, D. 11, 2nd 11, P. 17 or 18, V. 7, A. 10 or 11, C. not counted; finlets V. above and below.*

In studying this fish we have a very large round body, a thin and compressed head, labials and gill-rays compressed and covered, and we are impressed with a certain inflexibility or stiffness in him. He is evidently formed to give little opposition in passing through the water, but the propelling power, the tail and fins, is very small. It is doubtful if the sharp anterior dorsal is not used for defence, as unless excited the fish usually carries it flat. He cannot be called a swift fish. Like all gregarious fish which feed in large numbers, the food must be ready spread in quantities for their use. Thus no individual instinct is called out in each fish to pursue or capture its prey. Moving in large masses also, the whole must blindly follow a few leaders. We are not disappointed then if we find our fish low in the order of intelligence, if we find in his pouty and greedy mouth a certain resemblance to the batrachians or frogs. His asserted torpidity during winter, and blindness, both which conditions

*A very rare variety is found perhaps two or three times during the season at Halifax These have the zig-zag bars one-half the size and double the number. In some the bars are reduced down almost to lines and spots, and resemble a figured variety in Couch's British Fishes, 1865.

happen to the batrachians, favour these views, though I do not think we have yet sufficient proof to assert them as facts.

The membrane half covering the eye is asserted by the fishermen in early spring to cover the whole eye, hence perhaps the story of his blindness. His small and numerous fins, according to the Agassian theory, inasmuch as he resembles the embryo of all fishes, which have the fins in one narrow continued band from head to tail, also prove him low in the scale of intelligence.

He appears on our coast in early spring, according to Martin Harrigan, Halifax fish market, about May 15; they are then very thin and lean, and are going eastward, the fishermen observing them passing the harbour. The great body are supposed to spawn somewhere to the eastward, but they are never seen like herring during the operation. It is probable they spawn all along our coast, but in deep soundings. During July another run make their appearance, and these the fishermen say are some who have not joined the great spawning schools. About the middle of September they again appear, coming westward; their spawning now over, they rapidly become fat and recruited and remain till the middle of November, when they disappear. Thus from the middle of May to the middle of November they are upon the surface. For the remainder of the year they are hid from us.

Our coast trending north-east and south-west, the terms eastward and westward, must be taken as meaning north and south. Thus the spring opens earlier to the westward, the season is advanced, and the rivers westward are open and free from ice before the eastern. Salmon, herring and gaspereaux make their appearance in the Bay of Fundy—at Annapolis first, then at Yarmouth, Gold River, Chester, and are taken earlier at Halifax than at Cape Breton and Canseau. It would seem that as the sun leaves his winter quarters and low circle on the southern horizon and commences to form his great northern round, he is followed north by the great marine armies surrounding our coast, which ascend to the surface to luxuriate in the calm and warming waters, and to approach our shores. Of the cod family alone we know the winter quarters. All winter long they are taken 10 to 15 miles seaward in about 80 fathoms sounding. Of the rest, with the exception of the herring, which winter in the deep land-locked bays of Newfoundland, and

sometimes make unaccountable winter migrations, we know little. The mackerel are no exception to this rule; whilst on the surface they are very susceptible to stormy weather; a rough November sending them off, whilst they linger on the surface during the whole of a mild Indian summer till December.

Although our fishermen maintain that they perform biannual migrations east and west, that they set their nets facing the west in spring and facing east in fall, that they watch them passing from head point to head point, and doubtless those seen at rare intervals on the Labrador must have migrated there, yet I still think these migrations are but very partial, and that the great body of our mackerel retire to deep soundings, as it were, on our coasts, perhaps to bury themselves in the mud and ooze, in a semi torpid condition. Our fishermen affirm that their stomachs are found empty, very late in November, and the fatter the fish the emptier the stomach, as if they were preparing for hybernation, as our bears and marmots do under very different circumstances. The stomach of the mackerel from which I made my description for this paper, 27th October, was filled with about a table-spoonful of green pultaceous matter in which was a fish scale. But the later in the year the fatter the fish; no No. 1's are ever branded in spring or early fall. Thus they disappear in November very fat, and re-appear very lean in May. I am still of the opinion that our fishermen's views are in the main correct, and would again bear testimony to their accuracy. When we consider the immense quantities of food consumed by the large schools around our shores, we must at once perceive that a perpetual migration is necessary. They must continually seek new hunting ground. The various tides, currents and eddies, along our coast, must incessantly influence their motions, since these currents sweep down acres and acres of surface food for them; therefore we are prepared to hear of their appearing at uncertain intervals, of their leaving a coast for years, and then returning unexpectedly to it. There is no doubt that by patient observation of all the facts passing around us, and by comparing them with meteorological tables of past years, we might come to predict a good or bad fishing season, but that we could ever control one, would be beyond our highest expectations. For the two last seasons the catch has been very abundant on our coast. For

several seasons before it was very deficient. One reason advanced with some plausibility is, that they range about the mouths of our rivers to feed upon the young gaspereaux, just emerging into their salt water life, and as the dams and obstructions of our rivers are daily cutting them off their spawning grounds, this supply is rapidly diminishing, and therefore they are rapidly leaving us. But we are met with the fact that there are more mackerel than gaspereaux, that the supply is too limited. There is a small crustacean that covers the beaches in winrows, like a shrimp, in July and August. These the fishermen call mackerel bait, and by their quantity or scarcity predict a good or a bad season. One cannot but think the myriads of medusæ which fill our autumnal waters, must serve as food for them. Of their voracity and willingness to take artificial baits, the common saying, "a mackerel will bite at a red rag," is a strong but a true expression; but as this invariably leads us to a history of the mackerel fisheries, we will sum up in a few words our present knowledge of this fish. He appears in May lean and with spawn, and is seen passing eastward, and northward; some few remain passing up and down our shores; he reappears again from the north and eastward, (having spawned in deep soundings,) in September, very lean, rapidly recruits, and disappears during November very fat, to reappear lean again in early spring; that he is uncertain in the place of appearing, and that we need some exact practical facts as regards his food. Mr. Thomas Brackett, Halifax fish market, assured me that he had opened many mackerel this day, November 1st, 1865, and the stomachs of all were empty. He states that he often finds small fish in them earlier in the season.

This valuable fish, though low in the scale of organized beings, is much prized as an article of food, and is deservedly considered our most valuable export. His capture forms the most exciting work of all the wet, toil, and hardships our fishermen endure. There is chance in it—luck as they would express it. By one dexterous cast of net, he may make more than a month's work at the hook and line. Set nets, that is, nets about 30 fathoms long, and 4 deep, are stretched by their head lines between two buoys at the mouth of some inlet, and facing westward, about the middle of May. Many are thus taken. In early spring they are lean and filled with

spawn, but are readily sold in the fish market, or make good No. 2's, or second quality pickled fish.

It is very obvious that no creature should be harrassed during the spawning period, and one would at once say there should be a closed period during the spring for mackerel fishing, and that this is the principal reason for the decline of the fishery. Making rash laws, however, are to be deprecated, and our Legislature should first gain an intimate knowledge of the subject of sea and river fisheries, with all its bearings of food, of habits, migrations of fish, their mutual relations upon each other, and on the currents and tides that sweep our coasts, before they legislate away the summer living of men, often too poor to wait the fall supply.

Extricating himself from the nets and toils strewing his path eastward and westward for many a mile, but leaving many a poor fellow behind, branded prime No. 1, our fish now leaves our coasts, disappearing eastward. By the middle of September, especially if the nights are calm and warm, he comes to us again. Now is the grand sea harvest. The fishermen, those hardy reapers of the sea, are in picturesque groups on every headland or far jutting out point, with practised eye scanning the waters for the wake of the coming school. Inside of a deep bay they have their seine set, (a seine being 10 nets or 100 fathoms of head line, and 9 fathoms deep.) With one end attached to the shore it runs off at right angles, about 30 fathoms, where it is fastened to a buoy, it then makes an angle or L of about 30 more fathoms length, the foot ropes lying upon the bottom. At the end of the L a boat lies with the remainder of the seine, all ready to throw out. The look-out man now gives the word. The school is coming. With their eyes and heads just peeping out of water, their stiff inflexible bodies at an angle of 45, and a long train or wake curling back in the smooth water, there come a thousand greedy mouths and glittering eyes, slowly peering about for food, and following the indentations of the shore. Noiselessly and breathlessly the reapers of this sea corn do their work, for so wary is the fish, that a glint of light, a clap of the hand, or the swash of a rope overboard, or even the thud of an oar falling upon the boat, and the whole school is gone, to break water again far to seaward, and perhaps the $500,

so nearly bagged, goes with them. In profound silence they watch their prey till it runs quite up far within the bight or elbow of the seine. And then a few rapid strokes of the oars, and as many dexterous tosses of the remaining nets as the boat is rowed to land, and they have secured their prey. This is technically called making a stop. For 36 hours the fish swim in frantic circles, breaking the water every where, they then apparently sulk down to the bottom, and never come up again. These stops are made all around us, and within sight of our crowded streets. Our beautiful Basin is often alive with them, and then in addition, a smart schooner, the floating home of the fishermen now far from the rock hung cottages, adds her tall masts, spread alow and aloft with drying nets, to the pretty confusion of glittering fish, dotted head floats, smart whalers and busy men around.

So close do land and water, the dusty traveller, and the dripping fisher meet in these sweet spots, that I once saw a stop made on the very verge of the rail, and the puffing engine making a back ground to the group, as glittering fish were tossed up and shining dollars cast down, and the farmer returning with the price of the harvest he had watched and toiled over many a weary hour, or of the stock he had fed and folded through many a winter day, was exchanging it with the hardy sea farmer who ploughs no furrows but with his keel, who gives of herds he has never fed, and of harvests that nature has sown broad cast on a thousand rolling hills for him to garner with boat hook and sweep net, rather than reaping knife or bullock-wain.

These stops are made on many parts of our seaboard, in St. Mary's Bay, and Digby Basin, where fish weirs are substituted for nets, and all along the Atlantic coast, and find their way to Halifax markets in lots varying from ten barrels to one or two hundred. As they are included with the deep sea mackerel returns, it is impossible to ascertain the exact number of barrels taken annually by shore fishing; but the whole amount of both shore and sea mackerel fisheries for the year 1865, was somewhat above $1,000.000.

Art. II. On the Geological Features of the Bermudas. By J. M. Jones, F. L. S.

[*Read Nov.* 6, 1865.]

The geological features of the Bermudas are at once interesting and peculiar. The group may be styled a series of sandy islets, more or less covered with cedar trees; for wherever you traverse, either along the shore or on the more elevated land, sand lies beneath your feet, and the cedar tree is rarely absent.

It does not require much stretch of the imagination to conceive the origin of this group, as formations always in progress in different parts of the islands give a clue to what has otherwise proved a mystery.

I have already given an opinion as regards the original formation of these islands in the "*Canadian Naturalist*" for February, 1864. Granting a primitive foundation, most probably the result of volcanic action, at no great depth below the ocean surface, the current of the Gulf stream would supply ample material to form a basis on which the gradual process of islandic formation would be slowly perhaps, but surely developed.

It is to the coral zoophyte, however, that minim in Nature's chain, that the Bermudas owe their existence as a settlement fit for the human race to dwell in. Without its presence the massive barrier reefs which lie around far in advance of the main land acting as walls of defence against the encroachments of the tremendous seas which break upon them, would not exist; and the inhabited districts, where now the neat white dwellings stand snugly ensconced in groves of cedars, would soon be changed to scenes of desolation; for like the locality known as the "Sand Hills" in Paget's parish, the sand would be thrown on shore by the violence of the waves, and the driving gale would hurry it along, burying houses and cedar groves in its course, as it has done in the locality I have alluded to.

Speaking of sand it may be well in the first place to consider the composition of the Bermuda sand. Take it as it lies upon the beach, and you will perceive, without the aid of the lens, that broken coral and shell are the principal ingredients. Pink coloured substances are also seen intermixed. They are fragments of nullipores which coat the reefs and shore rock in abundance. The nullipore

fragments, however, are about in the sand, which is found at a distance from the shore, and this hill sand is much smaller in grain and of a dull white colour; probably owing to the same process which according to Darwin takes place at St. Helena, viz., the drifting up of the sea sand to heights above, and the winnowing occurring during the transit.*

In traversing the islands from one end to the other, and ascending the highest positions, the hills are found to be rounded at their tops. This state arises from the action of the wind upon the masses of sand; and from sections of hill sides laid bare by excavation for road and other purposes, it appears that the same kind of formation has taken place in olden time, the shape of the former hills being clearly defined by the hardened mass which covers the underlying formation, and separates it from the recent one above.

From a general survey of the Islands I take it that they rest mainly on a series of caverns, partly and wholly in some cases filled with red earth; but near the shores of the islands these caverns are kept clear of contents by the waters of the ocean, which every flowing tide, find entrance through channels in the sandstone rock. There are some parts, however, which from observation I am led to believe are not so honeycombed by caverns, and these lie on the south shore of the main island, in Paget, Warwick and Sandy's parishes, where the sandstone has become hardened by some particular process into a very compact and close-grained stone. Of this stone lime is made, and when large houses and public buildings are erected, the contract generally specifies that this south side stone shall be used, it being far more durable than any other found on the Islands. Some persons imagine that the locality where this description of stone is found is the oldest land in the group, but it would be rash to concur in this theory where so many cases of recent formations having the appearance of age occur, and especially when we take into consideration the fact, that calcareous deposits soon become compact under the influence of exposure to the elements. Close observation made by residents on the Islands can alone set at rest

*When I last visited the Paget Sand Hills, a house at the summit of the hills some distance from the shore was almost totally buried, the chimney top being the only portion of the dwelling seen. The sand was still slowly but steadily working its way, and a few years more will no doubt cause adjoining properties to fall a prey to its encroachments.

this interesting question. The cavernous condition of the foundation of the group has often led ignorant minds to suppose that the islands rest upon no secure basis, and the circumstance of brackish water always making its appearance wherever holes are dug to the level of the sea, has given more credit to the statement.

In speaking of the cavernous foundation of the Bermuda group, I must not omit to mention a phenomena which may or may not exist in consequence of cavernous communication with the outer sea. Near the eastern end of the main island there is an extensive basin some six miles in circumference, called Harrington Sound. It connects with the sea by a narrow passage at its western end, over which a bridge is placed called "Flatt's Bridge." When the tide without flows, it is carried with great force into the sound through this passage, and likewise when it ebbs, it runs out again with the same degree of force. Now, it would be imagined that with such an increase of water as a flowing tide pours into this lake a rise of a few inches at least would occur: but such is not the case. Not an inch does the sound rise, and when the ebb begins, the waters rush out again to sea with the same impetuosity; yet not an inch has it fallen. Now where does the incoming water at flowing tide go to? And where does the water come from, that replaces the amount lost by the ebb? For there must be some outlet to account for such a singular occurrence. It must be borne in mind that this passage through which the tide ebbs and flows, is the only connection the lake has with the sea so far as can be ascertained. Many reasons have been given, endeavouring to account for this curious phenomenon, but as yet I am not aware of any definite conclusion having been arrived at.

The neck of land which divides this Sound from Castle Harbour is filled with caverns, and presents above ground an uneven and picturesque appearance. Miniature valleys surrounded by rocky ridges, honeycombed into caverns large and small, in the lower parts of which may be seen the clear waters of azure tint, through which the tropic fishes of rainbow hues may be seen floating about; and shrubs and plants of many kinds jutting out of the holes and crannies of the sandstone, while overhead the sage and coffee bushes, cedars and palmettos grow in wild profusion. This is the far famed Walsingham, immortalized by Tom Moore, in his ode to

the Calabash tree, which in his time afforded a cool shade, as it does at the present day, to numerous pic-nic parties.

In this locality, I have noticed a curious circumstance, which lends a clue to the formation of certain cylindrical masses existing on the shore at Harris Bay and other places. Mr. Richard Wood, the owner of this lovely estate, showed me certain trees growing out of the solid rock. The stem of one tree, a palmetto, was closely surrounded by the stone, and fitted as tightly as a stove-pipe does into the stone in a chimney. Now when this tree dies there will of course be left a cylindrical hole, and were the rock it exists in within reach of the waves of the sea, this hole which has had its walls hardened by the water which has during many seasons trickled down the stem of the tree, would become a cylindrical mass standing by itself, while the more friable rock around would be worn away. This condition would exactly account for the curious circumstance I have alluded to as occurring at Harris Bay. At that position and close to high water mark, stands a collection of cylindrical masses hollowed within and marked with rust, which I think may be owing to the decomposition of the tree, which once grew in this cylinder when it was part of the surrounding rock, which has been worn away by the action of the waves or spray, which at this point falls heavily during southerly gales. From appearances I should say that these cylinders contained palmettos from their rounded shape at the bottom, which is characteristic of the tree's growth.

I have at the commencement of this paper alluded to the presence of red earth in the caverns. This red earth exists very generally over the surface of the island, and mixed with sand is the common soil of the islands. I have every reason to believe that it is composed of decayed vegetable matter, and this theory is borne out by an analysis which was kindly made for me by Dr. Albert Bernays, the analytical chemist to St. Thomas' Hospital. Colonel Nelson has expressed his belief that the red earth found in caverns was of animal origin, most probably accumulated masses of guano; but as Dr. Bernays has stated that no animal matter whatever can be traced, I think a vegetable character can only be assigned to it, for I see no difference between the cavern red earth and the surface soil, beyond a more compact appearance in regard to the former.

In observing road cuttings in different parts, we see at once how

these islands have become raised to their present height, Look at a cutting side. Above all you see some few inches of red soil on which trees and shrubs are growing, then two feet of loose sand, gradually hardening as it descends, the whole filled more or less with semi-fossil shells of *Helix Bermudensis* and other land shells. Thirdly we perceive a large cavern partly filled with red earth, an undoubted cavern deposit, then a smaller deposit, and then a regular bed of red earth again—the whole intervening space filled with hardened calcareous rock.

The lowest layer of red earth was once the surface soil, then drift sand came over it, cavernous holes occurred in the drifting sand, perhaps where a dense vegetation grew, the decomposition of which left the small mass of red earth at the bottom. A second drift again takes place, and then we have red soil and vegetation growing again—and so the land rises; but having attained a particular height, and becoming well clothed with a dense vegetation, it is a question whether under existing circumstances a higher elevation will be attained, unless some change should take place in the current of the Gulf Stream, when the Bermudas would most assuredly suffer in no slight degree, and the sand of the shore would make similar encroachments to those taking place in Paget's Parish at the present day.

To show the gradual formation of the Bermuda shores, we have only to take a walk along the sandy beaches, where we see large masses of sand, intermixed with gulf weed and debris of all kinds, in the form of a low wall above high water mark. These masses have been placed there by the action of the waves during storms. They are gradually hardening, and in process of time will become sandstone rock. On these masses again at intervals are thrown drift matter and tree trunks, some of large size, as I have seen myself. Among the roots of these trees are frequently seen pieces of stone of far different composition to any found on the Islands. These stones have undoubtedly been carried within the entwined roots of those drift trees from the continent of America. They are generally pieces of hard trap, at least all those I have been able to procure are so according to Professor Dawson.

I was not aware of the real origin of these foreign fragments when I hammered them out of the shore rock, about high water

mark, until Mr. Belt drew my attention to Darwin's statement in regard to similar occurrences on the shores of Pacific Islands. These foreign stones may be seen *in situ* at Point Shares in the shore rock. Pieces of decomposed iron are also found imbedded in the shore rock, brought there no doubt by wreck materials.

In considering the geological structure of the Bermudas, we cannot help noticing the similarity that exists in many instances between the accumulations occurring in the sandstone, near shore, and those on the shores of Pacific islands, and other places where calcareous deposits occur. On the south shore of the main island of Bermuda, I found in the friable cliffs some curious tubular bodies, hard and compact, which left a cast in the sand on removal. I thought they might be fossilized roots of trees. However, on comparing notes with Darwin's account of Pacific calcareous deposits, I found that the same substances had been found at King George's Sound, on the S. W. coast of Australia, and at the Cape of Good Hope. He styles them "branched bodies." "These branches," he says, "are absolutely undistinguishable in shape from the broken and upright stumps of a thicket; their roots are often uncovered, and are seen to diverge on all sides; here and there a branch lies prostrate. The branches generally consist of the sandstone, rather firmer than the surrounding matter, with the central parts filled either with a friable calcareous matter, or with a sub-stalagmitic variety; this central part is also frequently penetrated by linear crevices, sometimes, though rarely, containing a trace of woody matter. These calcareous branching bodies appear to have been formed, by fine calcareous matter being washed into the casts or cavities, left by the decay of branches and roots of thickets buried under drifted sand. The whole surface of the hill is now undergoing disintegration, and hence the casts which are compact and hard are left projecting. In calcareous sand at the Cape of Good Hope, I find the casts quite similar to those at King George's Sound; but their centres are often filled with black carbonaceous matter, not yet removed. It is not surprising that the woody matter should have been almost entirely removed from the casts on Bald Head, for it is certain that many centuries must have elapsed since the thickets were buried." In concluding his observations on these branched bodies, Darwin says: "Reflecting on the stratification of

the deposit on Bald Head—on the irregularly alternating layers of sub-stalagmitic rocks—on the uniformly sized and rounded patches, apparently of sea shells and corals—on the abundance of land shells throughout the mass—and finally on the absolute resemblance of the calcareous casts to the stumps, roots, and branches of that kind of vegetation which would grow on sand hillocks, I think there can be no reasonable doubt, notwithstanding the different opinion of some authors, that a true view of their origin has been given here."

Now, I have every reason to believe that these branched bodies found in sandstone cliffs at Bermuda, have originated in the drift sand covering shrubs or trees, when in a living state; but from observations I have made I consider their formation to have differed from that of Darwin's specimens. Rain water coursing down the opening made by the protruding stems and branches, would cause the sandy particles around to cement together, and form a hardened crust, which, like the cylinder of the palmetto I have spoken of, would, when the surrounding friable sandstone around was cleared away, stand firm. I am led to suppose this course of formation, on looking at a specimen which is hollowed at its centre, presenting as it does an appearance that would indicate such a course. On the rocky shore immediately beneath the cliffs from whence I obtained these specimens, large masses of sandstone rock lie detached from the cliffs, and these detached rocks as well as the cliffs, are perforated with holes, doubtless the casts of branched bodies which have shaken out from their original positions.

Not far from where I procured these branched bodies, at the S. E. corner of the Paget Sand Hills, cedar and other trees are now being gradually buried under drifting sand; and in years to come when the mass around them has hardened into rock, their stems and branches having wasted away, will doubtless leave behind branched bodies similar to those I found in another position, and also to those found by Darwin at King George's Sound, and the Cape of Good Hope. In some cases the branches may have been formed according to Darwin's hypothesis, by the entire decay of the whole branch, root or stem, and the refilling of the cavity left by sand; but as I said before, from observing that in some cases the centre of these Bermuda branches are hollowed, I must repeat again that I consider a gradual hardening of the sandy particles immediately

around the vegetable matter, first takes place, and when the decay becomes perfect the vacuum is filled by the same material.

Another circumstance I will now relate, which tends in some measure to shew the similarity of the Bermuda phenomena to those of the Pacific. Below the Paget Sand Hills, and on the shelving beach between high and low water mark, stand some remarkable rocks of the same consistency as the shore rock. One in particular stands perfectly isolated from the rest, and by the action of the waves has its base worn away, making it look like a large head upon a short neck. Although these rocks present a curious appearance, I should not have paid particular attention to them had I not found the occurrence of similar shaped rocks recorded in Dana's work, as existing at Waterland, one of the Rawehe Islands, in the Pacific. The rocks instanced by Dana, however, differ somewhat in consistency, being almost wholly composed of large fragments of corals of the *genera Astræa* and *Madrepora*, and imbedded shells, whereas the Bermuda examples were composed of the usual comminuted shell and coral, with imbedded shells. They nevertheless assimilate in many particulars, and afford evidence of similar agencies at work in coral groups, in the northern as well as the southern hemisphere.

From soundings taken along the outer reefs, it has been found that the Bermudas rest upon a partially columnar structure, for immediately outside these outer reefs the descent is precipitous, more especially on the southern side. To the westward, however, the column appears to be continuous for a space of thirty miles, for in that distance occur three or four masses of rock at a depth of about thirty fathoms. These are well known to the fishermen, who reap rich harvests when they visit them, fish appearing always to congregate in greater numbers wherever rocks lie.

It may be well to notice, that this extension of the Bermuda column is directly towards that point of the main land of America, which juts out for a considerable distance eastwardly towards the Bermuda extension, viz., Cape Hatteras. I mention this in order to point out a probability that in ages past the Bermuda column *may have been* attached to the main; for although I conceive, without conclusive evidence to the contrary, that the Bermuda column owes its origin to volcanic action, yet still as it at present remains a mystery, it will be well to consider the question of origin

in every light. Viewing the Bermudas as formerly a portion of the American Continent, let us consider whether there be sufficient ground on which to base our supposition. The Islands are formed, as I have before stated, of sandstone composed of comminuted shell and coral; but the particular stone which I have instanced as forming part of the southern shore, is so compact as to have the appearance of solid sandstone, or, indeed, I may say limestone. Now if we are to identify the Islands as forming part of that main land which juts out in their direction, we must first ascertain if that extension of the main be of similar formation. Speaking to Mr. Hill, the obliging mate of the R. M. S. "Delta," on my return from the Islands in 1860, I found that he was well acquainted with the American coast; and upon enquiry he informed me that the geological character of Cape Hatteras was decidedly a white sandstone or limestone, very similar in appearance to Bermuda stone.

I am sorry I have no specimen of the Hatteras stone, to compare with that of Bermuda, and I also regret that I have not had an opportunity of consulting any work upon the geology of that locality, whereby I could clearly ascertain the real nature of its structure. However, as I merely mention the connection of the Bermuda group with the main as a probability, and *nothing more*, and as my views are decidedly in favour of volcanic origin, we may leave the consideration of the question for future investigation, as I beg to do other subjects connected with the geology of the Bermudas, which, I hope, if life and health be spared me, to treat of in another paper.

Art. III. On Pisciculture. By Lieut. Col. Sinclair.

[*Read Dec.* 4, 1865.]

Viz.: Ombre or Grayling —*France* and *Italy;* Pike—*Italy;* Carp—*China;* Bream —*doubtful;* Tench—*doubtful.*

America could introduce *S. Fontinalis*, Pike, Perch, Gasperæux, Striped Bass, Black Bass, Cat Fish, Sun Fish, *S. Confinis*, and two other varieties of Lake Trout, one not yet determined.

Most varieties of the fresh-water fish proper of Great Britain are exotics, and were introduced by the learned monks of the ancient monastic orders.

These ecclesiastics expended much labour in preparing artificial lakes and ponds, which now exist, and still contain the scaly descendants of the old stock.

In those days, the transportation of live fish across the Channel or German Ocean, must have been a difficult undertaking. There is no account on record, showing that our ancestors were possessed of the knowledge that fish could be cultivated by means of milted spawn.

The Province of Nova Scotia should not be the last country to take advantage of, and reciprocate, the benefits which are likely to accrue from the late advancement made in piscicultural science. Her fresh-water lakes are of every conceivable size and kind; no country in the world offers superior natural advantages for a comparatively inexpensive introduction of many of the fish of the temperate latitudes.

The atmospheric isotherm of Nova Scotia corresponds with the south of Sweden; but her fresh water isotherm will approximate to that of central Germany, where the summers are warmer than ours, and the lake waters are frozen for two or three months during winter.

With one or two exceptions, the fresh water fish of temperate climes (indigenous or imported) cannot endure tepid waters; those few which *can*, do not suffer from hard winters, for the physical reason that the mean temperature of all waters is the same under a frozen surface.

The interchange of different varieties of fish by the agency of man, seems to be peculiarly indicated. In agriculture, the cultivation of exotic plants has much more to contend with: the same zones of latitude will not, as a rule, produce the same crops. For instance: Nova Scotia lies in the same latitude as the south of France, but will not ripen the finer sorts of wine grapes, the olive, and the fig. But the Province is somewhat nearer this condition than Great Britain, where the cucumber and maize will not ripen in the open air. The thermal condition of our lakes is higher in summer than that of the British lacustrine waters, and for a longer period; with reference to the hybernation of fish, for the reason already given, they may be ranked with lakes only frozen occasionally in winter elsewhere.

Aquatic plants give a good indication for comparing the waters of different countries, with the object of ascertaining whether they will sustain similar species of organic creatures.

The white and yellow water lily, the pickerel, and other lake weeds of this Province, are identical with those of Great Britain. There is a far greater diversity in the land plants and shrubs, which are indigenous in the two countries, proving that the thermal condition of their waters approximate much nearer than their atmosphere.

It is probably owing to higher temperature in summer, that many of our lakes have few or no trout in them. For this reason, they would be all the better reservoirs for other kinds of fish.

For instance: no one would now take the trouble to wet a fly in that fine sheet of water, the lower lake at Dartmouth; but were it stocked with fish, perhaps less esteemed than trout, it would afford healthy amusement to many who may not be adepts in the more scientific branches of angling. Enjoyment is only relative, and there are not a few who take as much interest in the bobbing of a cockney float, as in the rise of a pound trout; and even the experts might condescend to enjoy surer, though slower sport in the summer evenings, at a season when the trout, sickened with heat, refuse to take. As for the rising generation, they would be happier and better spending their spare time dibbing for roach, dace, tench, carp, and bream, than idling at home, or in city or town.

It would require a naturalist of practical experience to decide whether the white perch of America is the same as the British perch. It is not likely. The British perch, in all considerable lakes, grows to a very large size, and would probably do so here, where the native perch rarely attains the weight of two pounds.

Without pretending complete exactness, suggestive lists of fish are appended to this paper.

Possibly a correspondence with the Acclimatization Society in Great Britain, might lead to some results in an interchange of fish or spawn. As the delicate salmon roe has been transported and hatched successfully in the Antipodes, there could not be any difficulty or much expense, attending experiments of the same sort with other fish, by means of the mail steamers. The gaspereau would almost certainly thrive in Loch Awe and similar lakes, accessible to and from sea, and fed by a diversity of rivers and streams; and our trout, *salmo fontinalis*, would be no mean acquisition to the British lakes.

It is remarkable that the lithographic history of the ancient world reveals the fact, that there was then a difference of the fish

of the European and American continents, although they were less dissimilar from one another than either from modern fish. Some of the ganoid fishes had a vertebrated neck, and were thus able to look about them.

The same similarity prevails in the present day, when man is present to take advantage of it. The great *siluris glanis* of the Danube, whose introduction into Great Britain has caused attention, is undoubtedly one of the types of the large Channel cat fish of America, probably distinguished by some local peculiarity. The sturgeon of the Danube is most likely the same as the St. Lawrence sturgeon, with a difference.

Many of the European fish, if introduced here, might deteriorate in size and quality; but, considering the extent, purity, and varied conditions of our lakes, on the average, quite a contrary result may be confidently anticipated.

LIST OF BRITISH FRESH WATER FISH NOT FOUND IN NOVA SCOTIAN WATERS.

British Trout inhabits both lakes and rivers, as well as small streams, in which he will attain a good weight. Maximum weight, 10 lb.

Thames, and Colne, Driffield Brook, Waltham Tarn.

Affects deep holes in streams, and shallow gravel banks in lakes, and does not roam except near spawning time; runs very greedily at the minnow, particularly in rivers or streamlets discolored by recent rains; his habits are much more stationary and solitary than those of the "*salmo fontinalis*," or American trout; he also grows much larger in some waters than the *fontinalis*, which rarely, if ever, exceeds six pounds; seeks cover under roots and rocks.

B. Lake Trout — Maximum weight, 15 lb.; exceptional weight, one from Loch Awe taken five and twenty years ago, 30 lb.

Lochs Awe, Scotland; Neagh, Ireland; and other Scotch and Irish lakes. The Lake Trout of Cumberland is only an overgrown River Trout, over fed with minnows, found in Crummock Water and other lakes in North England.

There are several varieties — three or four, at least: —

1. The gillaroo trout, of Loch Neagh, which has a gizzard, and feeds partly on clams.

2. The great gray lake trout, of Loch Awe, is distinct from the gillaroo, unless the gizzard story be a myth.

3. The bull trout.

NOTE. — Naturalists are more obscure about the varieties of lake trout than about any other fish. It is impossible for a lay brother to form ideas from reading or catching.

Salmon Trout — Maximum weight, 9 lb.

Decidedly different from our sea trout; has no round white spots, or more obscure; scaled more like a salmon, larger size, and cuts red just like a salmon.

B. Grayling — Maximum weight, 4 lb.
Itchen near Winchester, Derwent, Wharfe, Done, and other rivers; varies much in size according to waters; is supposed not to be a "cold water" fish, but has lately been introduced into Scotland.

A delicate, very tender fish, excellent eating, taken almost always with the fly; likes a stream not too rapid, alternating with long clay bottomed glides, and gravelly streams; only one variety found on this continent; Back's grayling in the Arctic regions; the grayling, so miscalled, of Grand Lake, N. S., is a lake trout.

B. Pike — Maxm. weight, 40 lb.

Well known as a voracious fish, not to be trusted as an import; it is difficult to confine him, and he eats all before him, even his own species — frogs, young ducks, and any swimming thing less than his swallow.

Carp — Average weight, 2 lb., but will grow to 8 or 10 lb. invery favorable waters.

A tolerable fish for the table, but of no very superior quality; breeds prodigiously; Chinese by origin, but will live in temperate or even frigid climes; likes gravelly ground, in still waters.

Tench — 3 lb.

Pond and lake fish of very excellent quality; likes muddy or weedy places; stillwater fish.

Bream — 4 lb.

A fine deep-bellied fish, better than carp; he is a stillwater fish, and would most likely attain a large size in those of our lakes where trout are scarce; he gives good sport during summer, when few other fish will take — sport for float anglers, and a well-grown, good fish.

B. Perch — Much larger than the Provincial Perch.

A desirable fish to have as an experiment; might either improve or deteriorate in weight — would probably increase in weight.

B. Barbel and Chub.

Uneatable, and destructive of the spawn of other fish; they are the curse of English waters, and not fit for anything.

Roach and Dace — 1½ lb. (*Isaac Walton*, 2 lb., minus 1 oz., *Roach.*)

Sport for young anglers; tolerable "pan" fish.

Minnow.

Breeds in vast quantities, and useful in streams and lakes as food for trout and other predaceous fish, and a good bait.

Bullhead, loach, ruff, bleak, and a rare fish-burbot (*a siluris*), are not worth consideration; also, fresh water cray-fish, gudgeon, &c.

Charr — Small Herring size.

Of the cold deep lakes of the north of England; a very delicate fish, schooling in the autumn, when they are netted and potted for consumption and sale; difficult to transport, the fish being very tender, and their spawning habits obscure. The charr, if introduced, would be of great value. The *fontinalis* has been called a charr, but he is not the same fish at all. The lake charr has his seasons, and disappears and schools again just like the herring, not being seen but in his season.

PRINCIPAL NOVA SCOTIAN FISH NOT KNOWN IN GREAT BRITAIN.

Common Trout, *Fontinalis* — Sea Trout, maximum weight, 6 lb.

Colonel Drummond, a very acute ichthyologist, was of opinion that this fish and the N. S. sea trout are the same; that the *fontinalis* runs to the sea when able to get access to it, returning well grown, with a white scale. The *fontinalis* in our lakes is erratic, being constantly on the move in schools like mackerel.

Great Striped Bass — 6 lb. to 50 lb.

Would probably succeed in Loch Awe, and in the larger British rivers, where the shad is found, such as Severn, Ouse or Trent; also in rivers accessible from sea, flowing through lakes into estuaries, provided access be available; they would run up Shannon, but the Queen's gaps, lochs, weirs, or weir shoots are too steep; they are a large game fish, heavier than salmon.

Gaspereaux.

Do., of high economic value.

Salmo confinis — Maximum weight not known.

A lake trout of considerable size; would make a good exchange with the British lake trout.

Grayling (so called) — 3 lb.

A handsome white lake trout, not unlike a large salmon smolt fresh from sea.

White and yellow perch, small varieties of roach (shiners), suckers not included, being inconsequential.

ENUMERATION OF SOME OF THE AMERICAN FISH NOT FOUND IN NOVA SCOTIA.

Maskelunge, or American Pike. Lake Erie, Rice Lake, and other Canadian waters. 10 lb. to 30 lb.

Similar to the British pike, and that of Norway and the European continent.— See notes in British list.

Black Bass — 3 lb. Canadian rivers and lakes.

A superior fish, habitat lakes with deep rocky rivers, debouching into, or flowing out of them; he is allied to the perch, but will not breed in lakes without rocky rivers or runs.

Pike Perch — Habitat Canadian lakes and Continental American waters. Lakes Erie, Champlain, St John, Can. Richelieu River, and New Brunswick lakes; not found in Nova Scotia, but very much distributed in other American waters.

A handsome lake fish, more voracious than the perch, less so than pike; he does not exceed 10lb. weight, but averages 4lb.; has the spinous back fin characteristic of the perch tribe; is yellow, with a forked tail, finely tapered; his introduction is questionable. The pike is less actively formed, yet finds its way into apparently inaccessible waters. The pike perch would certainly thrive in our waters, also in the lakes and rivers of England.

Sun fish, cat, shiners, some smaller fry, and the fish peculiar to the great lakes, omitted; the large cat fish and *siluris glanis* might do in St. John River, New Brunswick.

APPENDIX — SUBJECT TO EMENDATION.

SEA FISH OF GREAT BRITAIN NOT FOUND ON THE AMERICAN COASTS. SUBJECT TO CORRECTION.

The Sole.

Desirable, if the water be not too cold on the outer Banks.

Turbot.
Large Crab.

Desirable.

John Doree.

Probably would not thrive, as he is a Mediterranean fish, requiring warmer waters than the Arctic current prevalent on these coasts.

Sea Bass of the South of England.
Prawn.
Shrimp.

Desirable, but water possibly too cold, on account of the Arctic current which covers the Banks of Newfoundland, and flows down our coasts as far as Florida.

The American sea fish non-existent in British waters, would not thrive on the British coasts and banks. The porgee, hog fish, red bass, drum, &c., are inhabitants of Southern waters.

NOTE. — The sheepshead, white fish, and fresh water herring, of the great lakes; also, the Mackinau trout, are the principal fishes omitted, as manifestly not adapted to our waters or those of Great Britain; two or three other fish are omitted for the same reason, but the lists can be amended. Controversy will be declined. — R. B. S.

Art. IV. Some Observations on the Fishing Grounds and Fish of St. Margaret's Bay, N. S. By John Ambrose.

[*Read Jan.* 8, 1866.]

As a list of the fishes of St. Margaret's Bay, is a lengthy one, I shall confine myself in this paper to an account of some of those salt water fishes, which form the staple export from this parish.

In the first place it will perhaps be necessary to give a general idea of the fishing grounds, especially off the mouth of the Bay. This I have obtained, and as far as possible, verified from the accounts of some of the most experienced and successful line-fishermen of Peggy's Cove and Dover.

Leaving Peggy's Cove on a S.S.W. course, we first pass over a "hard," *i. e.*, rocky, sandy, and gravelly bottom, for a distance of nearly half a mile, with a depth of fifteen fathoms, until we find ourselves over a depth of thirty fathoms, with soft black muddy bottom. This gulch extends in a line parallel with the coast, and opens into a similar one running up the Bay. It is about fifty yards wide, bounded on both sides by hard bottom, at an average depth of thirty fathoms. This muddy ravine is the celebrated "Hospital," where diseased codfish are found. Since my last account of this place, I find on further enquiry, that hake in a healthy state frequent it, as muddy bottom is the favourite feeding ground of that fish. But cod abhor the mud bottoms, and are only found in such localities when unable to go elsewhere. Healthy cod are caught at each side of this gulch, but within it the cod are found to be "logies," (*i. e., sick,*) and wounded fish. As codfish will attack and devour the helpless of their own kind, from the spawn up, a muddy gulch not frequented by their strong and rapacious brethren, is plainly a place of safety for the disabled, where by the simple and monopathic method of giving a wide berth to all interested parties, they hope for peace and convalescence, and wait patiently and humbly for such food as chance or a passing fisherman may throw in their way.*

Crossing the smiling waters, over this dark abode of sickness, want and pain, and finding our depth, from fifteen at the further side gradually increasing to thirty fathoms, at the distance of about

*There is another "Hospital" with muddy bottom, well-known as the haunt of sick cod, a short distance outside of Billing's Island, off Prospect.

a mile from Peggy's Point, we approach what at the fishers' point of view would be called a hill, rising from the plain to a height of nearly 130 feet, and having a sort of broken level at top, of some three or four hundred square feet, and at a depth of nine fathoms from the surface of the water. This is called "Quidi Vidi," and often affords excellent cod-fishing, as the rocky bottom on and around it, is the resort of such fish as the cod seek for their prey. After another space of deep soundings, we pass over a rocky shoal called the "Big Shoal," lying at a depth of ten fathoms, and affording good cod-fishing. We next pass over the "Nubbock," twenty fathoms deep. Other rocky shoals lie in different directions out here, having an average depth of about thirty-five fathoms around them, but the summits of all lying at a safe distance below the keels of commerce. At the distance of some eight miles from Peggy's Cove, we cross the "Ridge," a long hill extending from abreast of Pollock Cove to Green Island, some eight or nine miles. The east end of this lies at a depth of about 60 fathoms, but the west end shoals off to about 30 fathoms. The east or deep end consists of clay and rock—a favourite bottom for cod; the west end is rocky, also affording fair fishing. Next comes the "Inner Gulch" of black mud, about 60 fathoms deep and a mile wide,—then level bottom of sand and gravel, about 45 fathoms deep and two miles wide. We now pass the "Outer Gulch" of black mud, 60 fathoms deep and a mile and a half wide. Here are few or no fish, but a sort of large flounder or turbot, which is good eating; but for some unaccountable reason is known among our fishermen as the "Skunk." Next we pass "Cross Island Ridge," running parallel with the coast line, and like the former "Ridge," deepening towards the east end. This Ridge extends for a length of some ten or twelve miles. Next comes a gulch of black mud, 65 fathoms deep, and nearly three miles wide. Next are the "Shore Soundings," a sort of ridge extending like all the rest in a line parallel with the shore, shoal at the west and deep at the east end. The shoal part here, however, is sixty fathoms deep. Bottom, rocks and clay at the east end,—rocks at the west. Next we have the "Big Gulch" with a bottom of black and fetid mud, so soft that the lead buries itself in it. The depth here is about one hundred fathoms, and the width about three miles. Then comes a ridge, lying deep and narrow at the east end

and wider and shoaler at the west. The east end, i. e., as far as our men go, is composed of yellow clay, shells and small blue stones, and affords better cod-fishing than the west end, which is rocky, without the favourite mixture of clay and shells. The course from Peggy's Cove Point to the middle of this Bank is S.S.W., and here, looking back towards Aspotogan, we find the top of that well-known hill (a height, by the aneroid, of 410 feet,) just sinking below is our watery horizon. This ridge, extends along the coast from White Point at the Strait of Canseau to Cape LaHave, nearly approaching both these headlands. It is composed—at least that part of it which lies S.S.W. of St. Margaret's Bay,—of slate and quartz. Can it in any way form a sort of connection between the slate and auriferous quartz of Guysboro' and the similar geological formation at the "Ovens," and thus account for the gold washings on the shore at the latter place, which are known to wash in from outside, and become more productive after the heavy storms of winter?

But to return. On this Bank is found the best cod, ling and halibut fishing off our shore. Here lie at anchor, often for three or four days at a time, our venturesome open fishing boats, directly in the track of steamers and large ships, bound to the United States. A light is kept burning in the rigging all night, *but not unfrequently all hands*,—two or three in number—retire to their little cuddy, and having put a few sticks of wood into the stove, "turn in" for the night and sleep soundly till daylight, regardless of the steamers or ships, which in the darkness of the night often rush close past the little craft with her spark of a light,—so close, that one Schlagintweit of Turn's Bay, lying on this Bank, found after his comfortable night's sleep, that some large craft had passed him so closely and rapidly during the night, as to carry away his schooner's bowsprit, without awakening himself or any of his unconscious crew.

Here, one of our men, more vigilant, saw a brig in the night bearing down before the wind, right towards his little craft, and it was only by frantically shouting, snapping percussion caps on a musket, and waving fire-brands, that the notice of the brig's crew was attracted, and our poor fellows saved from sudden destruction. Here Tom Tomline, a fat and easy-going La Have skipper, having anchored his "Banker," hoisted a light in the fore-rigging, and

ordered all hands to turn in. All, nothing loth, were soon fast locked in the embraces of Morpheus, whilst the lantern, having burst, set fire to the fore-rigging, burnt up the fore-sail and that part of the hempen cable which lay coiled on deck, so that the schooner slipped her moorings, and drifted off, blazing, until a neighbouring craft sent a boat and awakened Tom and his snoring crew, just as the cinders were beginning to drop down among them from the burning deck over head. Here our open boats lie for three or four days at a time, riding like ducks on a sea which often obliges schooners to heave up and run in, owing to the superior buoyancy of clinker over carvel built vessels. The sea is heaviest in these off-shore soundings, when wind and currents contend against each other, for at times during summer the current sets so strong westwardly, that the fishing leads will not take bottom, but trail off at an acute angle. At other times there is little or no current. In spring this current sets southwardly, during summer westwardly, and in autumn in a south-easterly direction. Coasting vessels bound west often take advantage of this ocean current in the summer season, during calm weather or high head winds, by standing well off shore.

Here is the home of the large cod, ling and halibut, and here are abundance of bank-clams, scallops, and other shell-fish, which their admirers root out of the clayey valleys, on the sides of this submarine hill. Here is no end of star-fish of all sorts, as well as herrings, John Dorees, small cod, cat-fish and the other deep sea food of the more valuable fish. Here the cod are of a different kind from their brethren in-shore, being what are called "bull-eyed" fish, i.e., having their eyes very prominent, and covered with a thicker skin than ordinary. Both of these peculiarities are no doubt required for the great depths for which an all-wise and kind Providence has fitted them. Here a crew of three men will, in the course of two or three days fishing, catch from twenty to thirty quintals of cod, with perhaps a quintal or more of ling, and occasionally two or three, or even half-a-dozen fine fat halibut. Cod, generally, but cusk invariably, evert the stomach in being rapidly hauled up from deep water. After the stomach has thus been turned inside out, so as to project beyond the mouth, the fish, even if it break from the hook, will float to the surface, and

there die. Here, if the lines happen to drop in a good spot, such as a little ravine with a bottom of clay, sand and shells, the fish are very frequently caught in pairs, and as fast as the bait can be sent to the bottom.

My informants do not remember catching spawning fish of the cod kind out here, though at the proper season they frequently catch milters with the milts running out. Of the cusk spawners are found in October on this Bank, with ripe spawn in them. In the months of April and May, both cod and cusk bite best in day time, but from the beginning of June to the end of the fishing season, i. e., the last of November, they take bait most greedily during the night. Both also bite best in southerly and easterly weather, but when the wind is north-east they do not take bait readily, so far, as well as in their time of spawning, resembling the lake trout.

Cod and ling do not run together, but in separate schools, each kind by themselves, as indeed is the habit with most sea-fish. Ling are increasing on our outside fishing grounds, whilst halibut which formerly were plentiful and taken close in shore, are now scarce, even on the outer banks. The oil from the liver of the ling is much prized among our people as an outward application to sprains and bruises. The ling caught in deep soundings differ from the others, like the cod taken in similar localities, by having the eyes more prominent and covered with a thicker skin or film. The back skin of those deep water codfish too, is of a darker, bluer cast, than that of the in-shore fish, and the snout is longer and apparently better suited for digging shell-fish out of the clay. In all depths of water the colour of these fish in some degree resembles, that of the bottom on which they feed.

The in-shore codfish come into the Bay to spawn in October. These are not so long as the deep-water fish, but more junky. Some of the very large and long fish, also, come in at the same time for the same purpose. An immense one was caught last October, near Dover, but was so much mutilated in the splitting, that I was unable to get the accurate measurements of it. There is a tradition of one having been caught off Prospect many years ago, which when dried weighed one pound over a quintal.*

*Mr. Saml. Croucher caught a codfish, which when dried weighed 50 lbs. Mr. Benjamin Smeltzer caught one on a trawl this year, which measured 5 feet 10 inches long.

The in-shore cod, are what are known as school-fish, such as those taken at Labrador, (but slightly larger,) as they run in larger schools than the deep water fish. They spawn all around the Bay on gravelly and sandy bottoms. They will eat their own spawn, but have a great partiality for that of the lump-fish. When these dainties are not at hand, however, the cod is not at all particular about his diet. With "hunger-sauce" he will swallow almost anything. A jackknife was found in the stomach of one of these fish at Peggy's Cove. Another was found to have swallowed a "nipper," —i. e., a sort of woollen mitten, used by fishermen to prevent the chafing of their hands with the line. Some twenty-five years ago, a Mr. Weeks, of St. John, N. B., informed me that he found a man's ear in the stomach of a cod, which he had bought in the fish market of that city. When I was at Economy, N. S., in the month of March, 1846, a cod was caught near that place with a toad in its stomach. This unfortunate toad had, no doubt, on the approach of cold weather buried himself in some suitable place, but too near the edge of one of those sandy cliffs which overhang the rushing tides of the Basin of Minas, and this falling off at the coming out of the frost had carried with it the semi-conscious toad, to serve as a meal for the hungry cod prowling below. Unexpected reversal of confident hope at inhumation!

"The best laid schemes of *toads* and men
Gang aft aglee."

Mr. James S. Keizer, of Peggy's Cove, shot three murrs, on one occasion, off at sea, about eight miles S.W. of Peggy's Point. He immediately cut off the heads, which, with the intestines, he threw overboard, preparatory to cooking the birds. He then sailed on, with a moderate breeze, about six miles from the spot where the heads were left, to "Cross Island Ridge," threw over the grapnel, and beginning to fish, very soon hauled up a cod with a murr's head (quite fresh) in his stomach. He feels confident that this was one of the heads so recently thrown overboard by himself, at the spot six miles distant, as blood still remained on the feathers.

Codfish, like too many among mankind, will often by the indulgence of a depraved appetite, ensure their own destruction. The Maine-law or sea-regulation, confines them to a safe species of drink,

but their food is a snare to many of them. They greedily eat garbage, even of their own kind, and find backbiting at sea to be even more dangerous than the like-named amusement on shore, for the sound-bone of fish is too much for their digestion. Cod are frequently caught with a sound-bone, or even the whole undigested skeleton of a cod, cat-fish, or sculpin, in their stomachs, and part of the bony structure protruding through among the intestines. Others have diseased liver, that evidence of a disordered or weak stomach. The sick fish are called "logies" from the heavy lifeless feel of them on the line as they are drawn up from the bottom. The livers of logy cod are always more or less diseased. They are destitute of oil, and of a dark colour, and not unfrequently contain abscesses filled with pus. The liver always shrinks away to far less than the ordinary size, and the fish is found, though of large frame, to be wasted to mere skin and bone. Young fish are very rarely found to be inwardly diseased, so that perhaps, after all, the logies are aged individuals whose vital organs are impaired by the gradual decay of nature.

The livers of all our codfish are of a dark colour and destitute of oil, and the fish is watery in the early part of the spring; but as summer advances, and the herring strike in, the cod livers soon give evidence of the good effect of generous fare. Then the tail becomes round, firm and fleshy,—a sure sign of a healthy fish.

Having already given some idea of the cusk, in connection with the codfish, I shall not at present dwell upon the peculiarities of this excellent fish, which although increasing in numbers on our Banks, are still not thoroughly well known by our fishermen. Like the albicore, they appear to be of comparatively recent introduction here. They are caught on the Banks with ripe spawn in them, by which it would appear that they spawn in deep water; but I do not hear of codfish, those irrepressible egg-eaters, being caught on the Banks with spawn in their stomachs. Further investigation will no doubt in some degree clear up the matter.

There appear to be no logies among cusk,—a singular fact (if it be a fact), which piques the curiosity of the student in Natural History.

Leaving this interesting fish for the present, we come to the Hake or "Goat,"* as he is called by our fishermen, on account of the

*More properly the "Spotted Codling."

long tentacles which, beardlike, hang from his chin, and which—as he feeds on muddy ground, like the monk-fish (*Lophius Americanus*), may be intended to act like the tentaculæ of that sea-monster, to entice and deceive such unwary fish as go half burrowing along the oozy bottom in search of sea-worms. Hake are found in the muddy gulches, whither, except in sickness, cod never resort. Here in deep water hake are to be found in the early part of summer; but they strike in shore about the first of August, for the purpose of spawning, and remain, for all that is known to the contrary, until spring. Indeed, there is a small lagoon about three miles this side of Chester, across the neck or outlet of which the mail coach on its way from Halifax passes, by means of a small bridge. It is called "Frail's Pond," and is brackish, as the fresh water coming into it from the land side is mingled with the salt water which fills it at every tide. Here, throughout the winter, considerable numbers of good sized hake are taken *in day-time,* by hooks dropped through holes cut in the ice. These are, by our fishermen, jokingly called "tame goats." It is quite possible, and indeed probable, that this fish may also be found during winter in many other such brackish ponds, which are so numerous along the shore, between this Bay and Shelburne. I should also expect to find cod in such places, or in the mouths of the rivers along our coast in winter, for they are very frequently caught by the hand in the land-wash in this Bay, and in New Brunswick, in the Kennebeckasis river, off Clifton, and not far from Gondola Point, (where even at high tide the water must be but slightly impregnated with salt, and at low water must be very nearly fresh). Justus Wetmore, Esq., last summer informed me, that in the winter of 1864, large codfish were caught through holes in the ice. Indeed, the winter habits of our sea fish are as yet but little known, owing to the present habit of closing up the shore fishing from the middle of November, to the middle of May.

Hake take the same bait as the cod, and will freely take fish of its own kind, herein differing from cod, which after a few nibbles will desert the hook that is baited with codfish, though they will frequently devour small members of their own tribe. It may here be observed that every bait seems to have its own proper season,—

cod, for instance, ravenously seeking squid in the squid season, but showing rather an indifference to it at other times.

Hake are nocturnal in their habits, never taking the hook in day time at the outer ground; but when in the Bay and on rocky bottom in the spawning season, in the latter part of summer, and in autumn, on the dark days, they will occasionally take bait. Just before sunset during the night fishing, or "goating season," i. e., in autumn, the boats are all at anchor on the hake grounds, and as soon as the sun is below the horizon the work begins. If a seventeen feet whale boat with two men happen to hit on a good spot, she will load before midnight. Seven or eight quintals are frequently taken in a night by two hands, but it is very cold and disagreeable work in the frosty nights, about the last of October and during the month of November.

In the spring, though the liver of this fish contains no oil, it is white, and herein differs from that of the cod. In summer, as the herring begin to strike in, the hake liver soon becomes very fat and yields more oil than the cod liver.

When hake and codfish are salted in the same puncheon, the latter fish are made much tougher by the contact than they would otherwise be, and are therefore less prized for home consumption. Our fishermen always take good care to salt the cod separately, when intended to be used in their own families, or sold to such as are particular in such matters. Hake are very seldom used here, but are shipped to Halifax for the West India market.

There are but few logies among hake, and even these show no symptoms of organic disease. They are also full-grown fish, which would seem to indicate that old age is the principal cause of their sluggishness.

Haddock come next on our list. These lively little fish do not, like cod, ling, hake and halibut, keep always near bottom, but are found at all depths and bite greedily. When feeding on the bottom they are—like our worthy President and our patient and energetic brother Willis—great collectors of shells; and many rare specimens now adorning the cabinets of these enthusiastic naturalists, were brought from mysterious depths by the haddock. "The dark unfathomed caves of ocean bear" in our vicinity, but little which has not been inspected by the prying eyes and vigorous nose of the

haddock. They feed by day, and take readily any bait offered to the codfish. They also eat sea-Medusæ or "sea-squalls" as they are called here, and in this resemble the mackerel, which also feed on these jelly-like creatures.

Haddock keep outside in winter, leaving the Bay about the middle of December, and returning about the first of May. The best fishing within the Bay is from the middle of May to the end of June. At this season two hands in a boat will take seven or eight hundred, (equal to six quintals), in a day. It is of no use to attempt to catch codfish from among a school of haddock, as the latter give the larger fish no chance to take the bait. They feed on all sorts of bottom, muddy as well as hard, and are very gregarious in their habits. There are logies among them in spring and summer, but never in autumn. The logy fish are almost invariably afflicted with a sore under the sound-bone, full of pus, and in this case the liver is shrunken and contains no oil, and the stomach is empty. Haddock make a sort of whistling or squeaking noise after being caught.

These fish are salted and dried, like cod and hake, and no attempt has yet been made among us, to imitate the celebrated Finnan Haddies.

I must now draw towards a conclusion, having as yet only begun the enumeration of our fishes. I have had time to read but little on the art of catching and curing fish, but one cannot fail to see that a great deal remains to be done among us, in the way of developing and improving our fisheries, and preparing the fish for the most profitable markets. If the proposed negociations with Brazil and other Roman Catholic countries should open up new markets to our staple product, a great deal has yet to be learned by our shore and Labrador fishermen in the way of curing fish for such markets, for that which has been tolerated among the negroes of the Southern States and the West Indies, will not tempt the fastidious palates of the more civilized people, with whom we hope soon to trade. Time forbids my entering on the superior mode of curing cod, hake, haddock, and pollock, practised by the leading Jersey houses, which gives them a decided advantage over us in the fish trade. This point was touched upon by the late M. H. Perley, in his interesting work on the Fish of British North America.

But I may venture one more observation. I see that the motto of this City is "*E Mari Merces.*" This being the case, one would naturally expect that some little attention and encouragement would be bestowed by the citizens on one great source of this wealth, viz: —the Fisheries. Exhibitions of fruit and flowers are annually held in this city, and liberal rewards bestowed on successful competitors. This is all very well, and no doubt encourages horticulture and increases the number of conservatories. But when did we ever hear of a fish-show, or of prizes being offered for the best specimens of fresh and *well-cured* fish? Fishermen are expected to go on, hazarding their lives and eking out a mere subsistence in hopeless poverty and self-denial, almost unthought of by their superiors, whilst they keep up the most lucrative branch of industry in the Province; and though Agricultural Societies are gotten up, and fostered by Government, in order to encourage and teach the farmer, and supply him with the best stock and implements, we have yet to hear of the very first effort to teach or encourage the poor fisherman. But if we are to see our fish-trade expand under the contemplated treaties, this indifference must be shaken off, and a vigorous effort made to develope a great source of wealth which as yet is only in its infancy.

Art. V. The Auriferous Deposits of Nova Scotia. By P. S. Hamilton, Chief Commissioner of Mines.

(*Read Feb.* 6, 1866.)

In coming before the Institute this evening, with a few remarks upon the "Auriferous Deposits of Nova Scotia," I must say that my selection of a topic has been rather an acquiescence in the expressed wishes of others, than a deliberate choice of my own. I say this because of the difficulties which, according to what knowledge I have been able to gather, beset the scientific aspects of the subject; and which utterly preclude my producing a paper satisfactory to myself. I will therefore be brief and confine myself to the statement of a few facts upon the extent of the Nova Scotian Gold Fields, and the distribution of gold therein, and upon some geological and mineralogical phenomena connected with their deposits,

hoping that these facts, may be some slight aid to others in pursuing further researches into the subject.

The outlines of the well marked geological districts, which comprise the Gold Fields of Nova Scotia, are already pretty generally known. I will only briefly state that they consist of two distinct districts, of different geological ages. We have upon the Atlantic Coast the Lower Silurian rocks, forming a band which extends the whole length of the Nova Scotian peninsula. This district is not less than fifty miles in width at its western extremity, gradually narrowing as it proceeds eastward, and finally coming almost to a point at Cape Canso. The other district—the Devonian, and Upper Silurian—forms several comparatively lofty and isolated ridges. One of these extends from Digby County, along the south side of the Annapolis valley, to the vicinity of Windsor. Another commences at Cape Chiegnecto, forms the Cobequid Hills, and, with a slight divergence from its original course, proceeds eastward to the Strait of Canso, throwing off spurs north-eastward to the Gulf of St. Lawrence, and south-westward on both sides of the Stewiacke River. In the Island of Cape Breton, nearly the whole of Victoria County, a large portion of Inverness, and several detached eminences in Cape Breton and Richmond Counties, belong to the same formation. Among the gold bearing formations of this Province, I might also include the Trap ridges, considerable as to extent; for auriferous quartz has been discovered and to some slight extent mined, in the Trappean headlands of Partridge Island, and Cape D'Or; but I will leave this geological district out of further consideration.

The extent of the two larger districts which I have indicated, comprises, in the aggregate, a large proportion of the surface of Nova Scotia. I would roughly estimate the area of the Lower Silurian district, at 7,000 square miles, and of the several tracts of the more recent formation at 3,000, in all 10,000 square miles. The whole area of the Province of Nova Scotia, amounts to about 18,600 square miles. It must not be assumed that this large area is throughout auriferous. I will observe, parenthetically, that judging from what is already known, there is every reason to believe that future explorations will prove the greater part of this area to be rich in metalliferous deposits of some kind.

As to gold, I will begin with the Devonian district. The several ridges of high lands which come under this denomination have, as yet, been but little explored for gold; nor is it probable that they will be, to any great extent, for some time to come. These hills are, for the most part, in the interior of the country; their rocks are rarely exposed, being covered with a pretty deep soil, from which has arisen a heavy growth of timber. Gold has been found in the alluvium, brought down by many streams which take their rise in these hills. It has seldom been discovered, as yet, in quartz *in situ*; but, for the reasons just referred to, quartz *in situ* has seldom been seen in this geological district. In Wagamatkook, which is a proclaimed gold district, about the head waters of the river of the same name, in Victoria County, quartz has been mined to some small extent. The little done here in this way did not afford as good promise of profit, as has been met with in quartz mining elsewhere in the Province; but it cannot be considered a fair test of the productions of the district. Most of the gold obtained at Wagamatkook, has been taken from the beds of the streams which flow down from the hills; and the quantity thus procured indicates the presence of numerous auriferous quartz veins in the vicinity. Gold has been discovered in the sands of nearly all, if not all, the streams of Victoria and Inverness which take their rise in these metamorphic hills. It has also been found in the same formation at Cape Porcupine, near the head waters of the Musquodoboit and the Stewiacke, and, I believe, at Five Islands and elsewhere; so that gold may be sought for, with not unreasonable expectations of success, in any part of this geological district.

We have more reliable *data* as to the auriferous character of the better known Lower Silurian coast band; but even with respect to this, they are as yet very incomplete. We know that in the Lower Silurian district there are found bands of quartzite, seemingly nearly parallel with each other, alternating with various slates, extending in a general easterly and westerly direction. These bands are intersected by various masses of granite, in some places extending quite across the whole formation, but more frequently forming detached masses protruding through and surrounded by the stratified rocks just named. In this quartzite, and in a less degree, in some of the slates, we find numerous veins of quartz; and these

veins—especially those of the quartzite—we find to be auriferous. Of the number of the quartzite bands and of the latitudinal extent of each, little is yet known. It has indeed been stated that, between the Atlantic coast and the northern confines of this metamorphic district, there are six of these bands; that these represent six lines of upheaval, or east and west anticlinal axes; and that the slates found alternating with the quartzite are, in fact, superimposed upon it. This may be correct; yet I cannot but entertain doubts as to some of the particulars. First, a transverse section quite across the rocks of this metamorphic district has never yet been exposed to the eye of any man. Secondly, the supposed continuation of these quartzite bands from one known gold-bearing tract to another, as represented by the authority just referred to, is now seen to be not borne out by the facts—at least, not in every instance. Lastly, in one at least of these bands represented as embracing a single anticlinal axis, I have found several of such axes. From a general acquaintance with the country and not from actual survey, I am inclined to the belief that these quartzite bands are much more numerous than they have been represented; and that in the aggregate they form the largest portion of the width superficially of this metamorphic district, skirting the Atlantic.

Longitudinally, this quartzite, with its auriferous quartz veins, can, except when interruptions are caused by the granite dykes already mentioned, be traced the whole length of the Nova Scotian peninsula. Gold has been taken from quartz veins at Yarmouth, and on the shore of Chedabucto Bay, and, I might add, at every intermediate point where diligent search has been made for it in the proper formation. The quantity of quartz embraced in this great length and breadth of quartzite vein-stone, must be something enormous. I speak of it in comparison with the bulk of the enclosing rock. Of course we have no sufficient *data* from which to estimate this quantity. The opinion I have just hazarded is based upon observations of the few cross cuttings in the rock yet made, in the few localities of this Province where gold mining is yet carried on; and these openings have in many—I believe I might say, in most instances, been made at mere hap-hazard. On one occasion I myself removed carefully the drift, so as to expose a cross section of the surface merely of the bed rock, for a distance of about one

hundred and sixty feet. Within that distance, I discovered over thirty quartz veins, ranging from an inch to fifteen inches in thickness. The whole number of veins would average not less than six inches, or say fifteen feet in all, thickness of quartz, to one hundred and sixty feet of enclosing rock, the dip being here nearly vertical. In another instance after counting and measuring the quartz veins exposed within a distance of two hundred and fifty feet, I estimated their aggregate thickness at twenty-five feet; and yet, as within a part of the distance of two hundred and fifty feet, there was no exposure of the bed rock, the actual thickness of this quartz may have been considerably greater than what I have stated. In both of these cases, the quartz veins exposed, or the greater number of them, were known to be auriferous from examination made at the several spots where laid bare. In other localities, quartz veins of five, ten, and even up to thirty feet in thickness, are found. But I will not multiply instances. Those which I have specified do not, I think, exhibit a much greater thickness of quartz in proportion to that of the enclosing rock, than will be found generally throughout these quartzite bands. As already intimated, I thus judge solely from what is shown in excavations already made, and in Gold Districts of many miles apart. The surface of the gold-bearing rock of Nova Scotia, is for the most part concealed by a thin covering of drift and vegetable matter. Consequently it is an incident of no unfrequent occurrence for a miner, by some accident, or lucky blunder, to stumble upon a quartz vein of exceeding richness, the existence of which he never suspected, but which had lain almost within arm's length of where he and others have been toiling, perhaps with indifferent success, for months or years previously.

There is good reason to believe, then, that this quantity of quartz within easy reach of the miner, in Nova Scotia, is immense. The great economic question to be considered is: to what extent is it auriferous? It would be a sweeping and perhaps incredible statement to aver, that all of these quartz veins bear gold; and yet, so far as one can venture to hold any opinion at all, upon a subject upon which it is so difficult and dangerous to generalize, I rather incline to the belief that they all are more or less auriferous. Certainly the result of my own observations tends to that conclusion. I have seen and gathered some facts, concerning a great

number of these quartz veins that had been opened for the purpose of mining, or at least "prospecting." As to the results, individually, of these examinations, I must admit that I do not speak from notes taken on the several occasions; but speaking from memory I can recal no instance where I have seen a quartz lode fairly tested, which did not prove to be auriferous. I have seen a shaft sunk upon a previously untried lode, to a depth of sixty feet without a "sight" being discovered; and then the quartz has become exceedingly rich. In many instances very rich quartz lodes have been temporarily abandoned as non-auriferous, because the miner has happened to commence operations upon a poor section of the outcrop of the vein. It is possible that there are many other abandoned lodes, which will hereafter prove to be highly auriferous. Many quartz veins worked in Nova Scotia, have proved to be very rich in gold. The statistics of the Department of Mines show that, for four years past, the average yield of gold per ton of quartz has exceeded that of any other gold-quartz mining country.

The phenomena observable in connection with these auriferous deposits are almost wondrously various, and are oftentimes very puzzling to the man of science, as well as to the practical miner. These seekers after truth—and something more—are virtually in accord upon one point. Both wish to know the law of Nature by which gold has been deposited in quartz; for that law once being known, gold can be found without any waste of time, capital, or labour. But the miner, of course, looks solely to the end: the man of science, we must assume, regards only the means. I will briefly mention some of these phenomena, many of which are seeming inconsistencies of Nature.

Most of the auriferous quartz lodes which have yet been opened and mined upon in Nova Scotia, have the same strike and dip generally as the rock enclosing them. They are what some mineralogists call "beds," in contradistinction to "true veins," which cut the enclosing *strata* transversely. Yet these "true veins," or "cross leads" as the miners here call them, are found in all the mining districts. As a rule, they are considered unproductive and are not worked. Yet, in the Ovens Gold District, most of the gold obtained from quartz has been out of these cross leads; and in Oldham, a cross lead was accidentally struck, two years since,

which proved exceedingly rich, being in this respect, an exception to all other such veins in that district. Again, there are localities where little gold can be found, except at the point of intersection of the "main" and "cross leads"; whilst at that point, the expectation of a rich nest is not usually disappointed. There are A veins, the ridged tops of which are found beneath the surface of the enclosing quartzite, and which rapidly widen as they descend; there are V veins, which are wide at the outcrop, and as rapidly narrow down to nothing as they descend; and there are veins which extend with nearly parallel sides for a long distance, both vertically and longitudinally. There are also the beds of what is called "barrel quartz," which, when laid bare, exhibit a striking resemblance to great piles of prolonged trunks of spruce trees, from ten to fifteen inches in diameter, with the bark still on,—the corrugations of these quartz beds, and of the compact enclosing rock fitting into each other, as closely and accurately as the thread and groove of a male and female screw. Veins are found to be segregated—that is, they thin out to nothing in every direction. I am strongly of the opinion that they are all segregated veins. In some veins the quartz is of almost snowy whiteness, relieved only by the glitter of the golden nuggets it encloses. Such is the case with some at Tangier, whence beautiful specimens for ornamental purposes have been obtained. In other veins, foreign substances largely prevail. The rather celebrated "blue lead" of Sherbrooke, consists in great part of a blue slate, thoroughly pervaded—I may say—by a vitreous looking quartz; hence the name of the lode. Other veins exhibit a variety of metallic substances. Among them mispickel, or arsenical pyrites, usually predominates. It is often found in large masses, and sometimes the lode is more mispickel than quartz. This substance has been ascertained to be largely impregnated with gold; and considerable quantities of it are now carefully saved and sent abroad for more economical treatment than can be given to it here. The rich and well known "Hattie Lead" of Wine Harbour, like some others, is enclosed in a comparatively soft friable rock—so much so that a large portion of the miners' work has there been done by the pick-axe and crowbar, without the aid of blasting powder. The quartz itself partakes somewhat of the same character; and I have seen large specimens taken from this vein in which the

apparently shattered quartz was literally held together by clamps of gold. But this lode is erratic in its course, and does not seem to extend far longitudinally. On the other hand, at Old Tangier, the veinstone, where it has been operated upon, is of unusual hardness; whilst there the quartz veins are very regular and of long continuation, and the gold seems to be pretty equally distributed through them. The same contrast has been observed in Australia, between quartz lodes enclosed in hard, and those enclosed in soft rock.

What part of the quartz lode is most rich in gold? To answer this, as far as I can, is to point out some more of the vagaries of Nature. Early in the history of Nova Scotian Gold mining, I observed this fact.—Upon a quartz lode on and along which three or four mining companies were at work, their properties being contiguous, I had an opportunity of noticing operations daily for some months. This was a rich lode upon the whole; but the distribution of gold throughout the quartz was very uneven, and this in a manner most bewildering to the miner. I at length found that there were pretty distinctly marked sections of the lode which were much more rich than the intervening sections. These richer "streaks," as they have been called, did not run horizontally, nor vertically, as the miners first supposed when they found that there was an inequality in the distribution of gold, but *obliquely*. Upon a subsequent examination of several other auriferous quartz veins—some of them among the most noted in the Province,—I found that precisely the same rule applied to them. I supposed and am still inclined to suppose, that I had established a theory; but I would not venture to insist upon the universality of the application of this theory. In some veins, the greater portion of the gold is found in "nests," or "pockets"; and these pockets seem to be distributed, without regard to any rule whatever. In others, the gold is, with less extremes of variation, distributed throughout the vein, both longitudinally and vertically.

If we take cross sections of auriferous quartz veins and examine them, we shall find almost as great a diversity in the distribution of gold. In one case, we shall find the gold nearly all upon one side of the vein. Another lode, precisely similarly circumstanced, will show it upon the opposite side. In a

third—these cases are more rare—it forms a plane, or leaf, in the middle of the lode. Again, it will be mostly found in the slate "casing" of the vein, and not in the quartz itself. In most cases which have come under my notice, however, the gold is scattered throughout the thickness of the quartz and casing; and is sometimes quite invisible to the naked eye. Until very recently, it has almost invariably been found that quartz lodes became richer in gold as they descended. Facts have lately come under my notice which tend to show either that this rule does not apply to all lodes, or that at least it does not apply to all beyond a certain depth.

I would like to conclude with some remarks upon the theories, which have been offered to the world as to the origin of gold in quartz; but to do so with any justice to the subject at all, would extend this paper to unreasonable limits.* I will only now say, with some hesitation indeed, and with all deference to the opinions of the many learned men who have discussed the subject, that the quartz veins of Nova Scotia, on a careful examination of them, seem to me to present serious difficulties, to the adoption of the theory that gold was deposited there from aqueous solution; and also to the adoption of the opposing theory, that its presence there is the result of igneous action. I suspect, perhaps with improper incredulity—that the secret of the formation of auriferous quartz deposits, yet remains to be divulged.

Art. VI. Notes on the Weather at Halifax, Nova Scotia, during 1865. By Colonel Myers.

[*Read Dec.* 4, 1865.]

The cold of the winter of 1864–5, seems for the most part to have expended itself during the latter part of December, 1864; and January, 1855, began, and continued throughout, mild and serene. The mean temperature was 22°, one degree less than that recorded on the same month of the previous year.

High winds prevailed during February, but the weather generally fine and mild for that month. Mean temperature 24°, being 2° less than in 1864.

*Perhaps I may, in some future paper, recur to this branch of the subject, which must be by far the most interesting to the scientific mind; but it is the most perplexing to deal with.

March generally fine, with an almost entire absence of the stormy weather which frequently attends the vernal equinox. Mean temperature 34°, being 6° higher than in 1864.

April was for the most part calm and fine, with indications of an early spring. Mean temperature 40°, exceeding that in 1824, by 4°.

The rainy, foggy, and unsettled weather of May, caused a serious interruption to agricultural operations, compensated, however, to some extent by the impulse given to the grass crop by the warm moisture. Mean temperature 49°, one degree higher than in 1864.

In June the weather was very fine and calm; but frosts, which occurred in some parts of the Province, did much injury to fruit trees and gardens. Mean temperature 58°, one degree higher than in 1864.

July was also a very fine month, most favourable to hay-making, which, in the neighbourhood of Halifax, began about a fortnight earlier than usual; and generally through the country the crop was safely housed. Mean temperature 60°, being 2° below that in 1864.

August generally fine, with the exception of some unsettled foggy weather towards the end of the month. Mean temperature 63°, one degree below that in 1864.

September very fine throughout. The autumnal, like the vernal equinox, was remarkably free from gales of wind. Mean temperature 57°, one degree higher than in 1864.

October, much unsettled weather during this month, with some gales towards the end of it. Mean temperature 44°, being 2° below that of 1864.

November unsettled, with much rain. The month ended with a heavy gale from S.E. Mean temperature 39°, the same as last year.

December generally fine for the season. A sharp, though short, gale occurred on the 21st, when the barometer fell to 28.51; and the 22nd, 23rd, and 24th, were very cold days. Mean temperature 24°, being 3° lower than in 1864.

The highest temperature in the shade recorded during the year, was 85°, on the 3rd August; the lowest—6° on 23rd December. The highest monthly range was 49° in May; the lowest 35° in July. The yearly range was 91°.

The hottest month was August: the coldest January. The mean temperature was the same as last year, viz: 43.

The highest reading of the barometer during the year was 30.35, on the 14th March; the lowest 28.51, on 21st December. The highest monthly range was 1.59 in December; the lowest .59 in July and September. The yearly range was 1.84. The mean for the year 29.65.

The annexed table (see appendix), gives the monthly and yearly means and range of the temperature, and atmospheric pressure for the years 1863, 1864 and 1865, deduced from three daily observations. The comparison of these three years, one with the other, exhibits a remarkable equability as well in the monthly, as in the annual results.

The most prevalent winds during the year were N.W. and S. W.; the least prevalent E.

Rain fell on 136 days; snow on 52; hail on 3; fog occurred on 60 days.

Auroræ Boreales were observed on 55 nights; solar halos on 5 days; lunar halos on 12 nights; thunder storms occurred on 4th March; 25th May; 29th July; and 23rd October. Lightning was seen, but thunder not heard, on 23rd June; and 1st September. Thunder was heard, but no lightning seen, on 9th and 17th May.

The latest snow in the Spring fell during the night of 6th, 7th May; and its earliest appearance in the autumn was observed on the forenoon of 21st October. July was the only month entirely free from frost.

The weather during the year was generally fine. The winter of 1864–5 was remarkably mild, and broke up early. A humid spring was succeeded by an extremely dry summer, occasioning ndeed inconvenience in some localities, but favourable to the hay crop, which throughout the country was abundant and of excellent quality; nor does it appear that other crops suffered to any great extent from the dryness of the season.

Drought, with the temperature above the average, seems to have been, in the past two summers, the abnormal climatic condition of many parts, not only of the American, but also of the European Continent; followed this year by great atmospheric disturbance in

the North Atlantic, and, in this Province, by a winter of unusual severity.

The storms, which, in the autumn and early part of the winter, swept with such destructive violence over the Atlantic, did not visit Halifax, whose exemption during another year from any remarkably stormy weather, tends to support the hypothesis of the late Judge STEWART, that it is the centre of a storm circle. Another idea, broached by the President at our last meeting, in connection with Mr. Hurdis' paper on the recent storms on the English Coast, is worthy of consideration, viz: "That tropical hurricanes take the course of the Gulf stream, and, repelled from this coast by the cold barrier caused by the Arctic current, pass to the eastward of Halifax, and are thrown upon the western coasts of Europe." Yet supposing this to be the case, it remains to be accounted for, why gales, which prevail in many of the neighbouring countries, approaching, in our own Province, as near as Truro and Windsor, so seldom reach Halifax. It may be, that storms, travelling from the south along the eastern coast of America, pursue their course up the Bay of Fundy, and, leaving Halifax to the eastward, pass on to the Gulf of St. Lawrence; but all that can at present be said is mere conjecture, nor are we expected to arrive at any satisfactory solution of the many difficulties which surround a question of such importance to our maritime and fishing interests, till stations shall have been established in different parts of the country, from which reliable reports of the course and strength of the winds at each place may be received daily. Extracts from the log-books of vessels, which, on approaching this Port, encounter stormy weather, would be of valuable assistance in the investigation of this interesting subject. Let the cause, however, be what it may, there is the fact, that Halifax is rarely visited by destructive storms. Its noble harbour too affords a safe refuge from the tempests without, and an easy access, at all seasons, to a country possessing a climate as fine and healthy as any in the world, with abundant resources, in its minerals, fisheries, and agricultural capabilities, the development of which opens to the capitalist a productive field for operations, and to the enterprizing and industrious of all classes, a fair prospect of independence and prosperity. That Nova Scotia affords advantages such as these, ought to be widely published abroad, for, once known.

they will hardly fail to attract the tide of European emigration towards the Province.

Among the Auroræ Boreales observed during the year, two of very singular appearance, which occurred in the month of February, seem worthy of particular notice.

On the night of the 21st February, a fine Auroral Arch was seen to span the northern sky, from east to west, at about fifteen degrees above the horizon. At 9 P. M. the eastern extremity of the arch began to double under the other part, till it assumed the form of an oval, with the circumference nearly completed. Occupying the space in the sky from which the arch had receded, there then appeared a dark mass, resembling a huge rock, having the distorted arch to the westward, while from its eastern side bright streamers shot forth. The whole shortly afterwards broke up into luminous patches which spread themselves over the sky, even beyond the zenith; a belt of light remaining on the northern horizon till midnight. The second of these remarkable appearances was on the 25th February, when at 10 P.M. an arch was observed in about the same position as that last described, studded on the upper surface with luminous balls, if I may so term them, each having a halo of bright rays, presenting altogether a most magnificent object. Streamers were at the same time floating over other parts of the heavens. The arch, after having apparently absorbed its curious appendages, remained gradually decreasing in brilliancy, till about midnight, when it disappeared.

The following periodic phenomena were observed for the most part, at the Dutch Village:—

March—11th, flocks of wild geese passed over Halifax; 26th, Mayflowers picked in the woods near the tower; 29th, butterfly seen, and house flies make their appearance, a honey bee flying about, and "water boatman," beetle stirring in ponds; 30th, grass sprouting in meadows.

April—1st, a cowslip, unprotected during the winter in a garden, in bloom; young leaves of clover fully formed; 3rd, young ants lively under stones; 4th, "Camberwell beauty," butterfly about; 8th, lilac in forward bud, and frogs pipe at night; 9th, water spider in ponds; 10th, frog spawn in ponds; 11th, honey-

suckle in bud; 14th, aspen bursting into flower; 16th, migratory thrush sings at early morning; 18th, a swallow seen by Mr. Gossip, at Hoosier's River. I am not aware that an earlier appearance in this Province has ever been recorded. 26th, hacmatac, withrod alder, and blue berry in bud; large copper butterfly about; 27th, small blue butterfly appears; 28th, Mayflowers abundant, ants busy about their hillocks; 29th, white violet in flower; garden currant, and wild rose bursting into leaf; 30th, meadow crow-foot well up, swallows appear.

May—2nd, dandelion in flower; 30th, withrod bursting into leaf; 4th, dock in full leaf; 5th, blue violet in flower, lily of valley in full leaf, hermit thrush sings, black flies appear; 6th, leaves of white birch unfolding; 11th, blackberry and elderberry in leaf; 12th, wild strawberry in bloom; 14th, spotted snake first seen, red maple leaves bursting out; 20th, mountain ash, white birch, beech, blackberry, red maple, and wild cherry in leaf; timothy grass, pigeon-berry, and moose bush in flower; 21st, azalea flowers just opening, blueberry and wild cherry in blossom, balm of Gilead poplar in leaf; American toad about; 26th, apple, pear, and plum trees begin to blossom, buttercup in flower; 28th, aspen in full leaf; 31st, "painted lady" butterfly about.

June—1st, swallow-tailed butterfly first observed; 10th, white weed in blossom; 11th, wild strawberries ripe; 13th, small copper butterfly about; 22nd, brown cockchafer very abundant.

July—18th, pigeon berry in fruit; 28th, wild raspberries ripe.

August—10th, blackberries ripe and abundant.

September—2nd, leaves of white birch turn yellow, and begin to fall; 3rd, several maples turn colour in the Dutch Village woods.

October—11th, maple leaves falling fast.

December—2nd, snow birds seen on the common.

Wild fruits of the field and forest, were extremely abundant in the autumn, especially blackberries and huckleberries.

Before bringing this paper to a close, I would briefly advert to the progress Meteorology is making in the world. In England, the "British Meteorological Society," an institution of not many years standing, publishes every quarter its proceedings, containing a large amount of information, useful and important, not only to the scientific, but to almost every class of society. The system of storm

signals too, has been brought to that state of perfection, that the indications they give of approaching gales are rarely incorrect. Yet it is difficult to persuade men, especially sailors long accustomed to rely upon their own judgement with regard to the weather, to place that confidence in this practical application of science which it deserves. How different might have been the fate of the hapless steamship "London," had the storm signals, hoisted at Plymouth, when she was leaving that Port, been attended to: but it was probably the undaunted courage of the captain, so conspicuous throughout the subsequent trying scenes, and too great reliance on the powers of the fine ship he commanded, which caused him to disregard the warning; the deplorable result of which carried desolation and woe to many a bereaved household, and a thrill of horror to the hearts of all who heard the piteous tale of the foundering of that vessel, with upwards of two hundred souls on board.

From the governments of almost all the great nations of Europe, this branch of science is obtaining the attention it merits; and in Russia especially, measures are being adopted for its application to the foretelling of approaching storms, for the use of sailors and agriculturists, on a scale commensurate with the vast extent of that Empire. On the seaboard and inland, upwards of one hundred meteorological observatories, furnished with complete sets of instruments, have already been established, from which communications by telegraph are received daily at a central station. Nor are operations confined to the land, but are carried on extensively at sea under the directions of the government. Arrangements are also in progress with France, Prussia, Italy, Austria, and Holland, for a gratuitous interchange of meteorological observations between these countries.

Nearer home, there is in the neighbouring Republic the Smithsonian Institute, doing a vast amount of good in developing this and other sciences, encouraged by, though, I believe, independent, in a pecuniary point of view, of the aid of the government.

But leaving these old and well established countries, we find the governments of many of our own colonies becoming alive to the advantages to be derived from the cultivation of science among their people: Australia and Canada, not to mention others, liberally assist all efforts to that end. In the latter are several observatories, each

of which, if I am correctly informed, receives a Provincial grant for its support.

With such examples before us, we may surely venture to hope, that Nova Scotia never backward in promoting whatever has a beneficial tendency, will not refuse to extend a helping hand to this Institute, whose publication of its transactions every year is diffusing, at home and abroad, much valuable information respecting the resources and capabilities of this fine Province, but whose endeavours to become of more extended practical utility, are paralysed by the want of the pecuniary means, requisite to enable it to carry out effectually the objects it has in view.

Art. VII. Notes on the Economic Mineralogy of Nova Scotia: Part III.; Limestone and Marble. By Prof. How, D. C. L., *University of King's College, Windsor.*

(*Read Feb.* 6, 1866.)

Limestones.—These are found in practically inexhaustible quantities in the Province, where there is estimated to be a thickness of thirteen thousand feet of the various strata comprising the carboniferous system, among which limestones are frequent, especially in the lower carboniferous beds, which in fact consist largely of them and measure six thousand feet in thickness. This system is developed almost exclusively to the north and north-east of the capital, in which part of the Province upwards of eighty beds of limestone are indicated in Dawson's geological map; the rest of Nova Scotia, including the whole western portion and the southern shore, has but two small patches of carboniferous rocks. The limestones have sometimes been thrown by metamorphic action into the crystalline state, and frequently converted under these circumstances into marble, so that many varieties of this material are met with. Geological details respecting this deposit are given in Dawson's *Acadian Geology.*

The economic value of the limestones will probably always be found in the making of lime for washes, mortar and cement, and for manuring, and in their use as fluxes in iron smelting, since the great abundance of excellent freestone will almost preclude their use as a building material except in rubble work and making foundations. As

regards the use in manuring, a considerable portion of the agricultural districts in the Province lies in the formation affording limestones, and except for special and occasional purposes lime will not be required in their cultivation—but it must find profitable application by the farmers in the rest of the Province where lime rocks are altogether absent or but scantily developed. In recent years stone bridges have been constructed for railways, and wooden buildings have been replaced in the capital by those of brick and stone; before this change there could have been little demand for lime, which must have been used chiefly for building foundations and chimneys, because the walls and ceilings would be almost everywhere of the plaster made from the gypsum, which is found as the very frequent associate of the limestone.

On comparing the census returns of 1851 and 1861, we find, of course, that with the progress of the country there is increased use of lime. In the former year there were burned in the Province 28,603 casks; taking four bushels to the cask, which is St. John measure, the amount will be

Lime burned in Nova Scotia in 1851, 114,412 bushels.

By the late census we find there was of

Lime burned in Nova Scotia in 1861, 136,848 bushels.

And no doubt, for the reason just given, the next census will show as great an increase as the latter numbers do over the former.

As regards the amount of lime employed, Mr. Lang thinks tha for the last five years not less than eight to ten thousand barrels o lime have been used per annum in the city of Halifax, and that there will be wanted from seven to eight thousand pounds worth of lime during the ensuing summer.

The details of the census returns are interesting: they show that five counties only burned no lime and that the rest of the eighteen gave very different quantities:

CENSUS RETURNS FOR 1861.

Counties.	*Bushels of Lime Burned.*
Colchester,	4,860
King's	
Cumberland,	10,635
Annapolis,	
Pictou,	35.990
Hants,	17,474

Counties.	*Bushels of lime burned.*
Sydney,	3,232
Inverness,	6,486
Halifax,*	26,050
Lunenburg,	3,100
Yarmouth,	3,500
Digby,	
Guysborough,	320
Victoria,	4,730
Queen's,	
Shelburne,	
Richmond,	406
Cape Breton,	20,092
Total,	136,848

It is perhaps remarkable that, notwithstanding the vast profusion of limestone in the Province, a good deal of limestone is imported from the West Indies, and much lime from New Brunswick. There is no doubt that the native rocks yield with careful burning excellent lime, and the cost of it is probably less than that from the foreign rocks. At Windsor lime will sell at the kiln at three and sixpence the barrel, and the price would be lower if there were more demand; as it is I am told the New Brunswick lime costs more money: for some reason however, the latter often obtains the preference, as was the case in building the new library at King's College, Windsor, in the neighbourhood of rocks affording excellent lime, as will appear by an analysis in a subsequent page. This is not, however, an invariable rule, and the Nova Scotian stone has been used and found to give excellent lime: in the construction of the railway bridges on the line between Halifax and Windsor, lime from the neighbourhood of the latter place was employed and gave great satisfaction to the engineer, who pronounced it to be a very "strong" lime. A limestone found at Indian Point, Chester, of a deep blue colour, yields a lime which becomes as hard and lasting as a cement: the rock is much valued in Halifax for building up the arches of kilns, a situation in which poor limestone crumbles away while this remains quite hard. The lime prepared from this rock was preferred to that from New Brunswick in building the Wellington Barracks, in Halifax.

*The greater part of the lime burnt in the city, Mr. Lang thinks, is from foreign limestone.

Mr. Peters, the builder of the barracks, is my authority for this character of the Chester rock and he tells me that the lime from it is the only one yet found to his knowledge fit to use in making concrete. A black limestone is found at St. Peter's, Cape Breton, which is said to afford most excellent lime.

Hydraulic Limestones.—These are limestones which contain a certain proportion of clay and sometimes magnesia and have in consequence the valuable property of setting under water after being burned to the proper degree.* These important minerals should receive careful attention ; they are reported to exist in several parts of the Province. Mr. G. Lang informed me last year that Shubenacadie affords a limestone the lime from which was used twelve years ago in building a chimney for a steam-engine and that the work under water cannot now be separated. He says now that this lime takes the first place in the family of limestones on this continent as affording a lime for mason work and for all exterior work. The lime from it slacks with unusually little water and takes as much sand again as any other used in the country, and makes a mortar which is better than any cement except the Portland, made in England, resisting the severe frosts and sudden thaws much better than that made with lime from St. John or West Indian limestone. He has burned about 300 tons and now has his kiln ready to burn about 2,000 tons. Hydraulic limestones are also reported from Windsor, and from St. Peter's, Cape Breton.

Cement-stones are limestones containing foreign ingredients, which when burned and ground can be made into cement. Mr. Handley, of Halifax, showed me a cement he had used in putting together firebricks, which he had made from a stone found near St. Peter's, Cape Breton, by careful burning, grinding and mixing with sand in certain proportions: he assured me it was a very strong cement. Such stones are very valuable : during the construction of railways and other public works in Canada one manufacturer made on the average 80,000 bushels of cement annually. The limestones of Walton and Teny Cape, in Hants Co., often contain magnesia, but in what quantity is not known, nor have they been examined as to their hydraulicity. A good deal of work on this subject awaits a

*An excellent account of these is given in Weale's Series on "Limes and Cements." See also Chem. News, xii p. 287, and xiii p. 86, and Geology of Canada, 1863, p. 805.

geological survey. Limestones fit for making lime for manure are those which are nearly pure carbonate of lime. I have heard it objected to the use of Windsor lime as a manure that it contains magnesia in large quantity; this is certainly not the case with that obtained from the rock on the property of O. King, Esq., for when I made an analysis of a specimen of that found on the bank of the Avon behind his house, it gave me:

Carbonate of Lime,	97.64
Carbonate of Magnesia,	1.10
Oxide of Iron,	.07
Clay, sand and silica,	0,68
Phosphoric Acid,	traces
	99.49

results which show that there is but little magnesia in it, even for an ordinary lime; for the sake of comparison I may state that in Professor Anderson's "*Elements of Agricultural Chemistry*," the analyses of two common limestones are given as examples of the composition of these rocks, and 1.61 and 7.45 are the respective percentages of carbonate of magnesia.

As many limestones of the Province, like that of which the analysis has just been given, are chiefly made up of the shells of *mollusca* it will not be out of place here to give an unpublished analysis* of a recent shell made many years ago; the cleaned shell of the Periwinkle (*Litorina litorea*), gave

Carbonate of Lime,	97.175
Sulphate of Lime,	.479
Organic Matter,	2.010
Phosphoric Acid,	0.001
Silica and Sand	0.164
	99.829

whence it appears that there is not a great difference between the composition of the recent shell and the rock which, many hundreds of thousands of years ago probably, was to a great extent made of the remains of the shells of allied animals.

*Published with others since this paper was read, in Silliman's Journal of Science, May, 1866.

The presence of phosphoric acid in a manure is valuable in most cases, and there are limestones in which this acid exists in considerable proportion, as Dr. Dawson mentions in speaking of those found at the Joggins: I have examined one of these, of a black colour, which I obtained from a bed on the beach and can fully confirm his statements; I found in it a notable amount of phosphoric acid; he justly says that such would be worth about three times the price of ordinary limestones, and that the richest of the beds found would possibly be sufficiently appreciated on trial to allow them to be profitably worked.

(I may mention here that a deposit consisting in small part of carbonate of lime, but made up mostly of clay and sand found near Mill Village, Parrsboro', was examined by me some time ago at the request of Rev. W. King, and found to be so rich in phosphoric acid that it ought to prove a good manure).

Limestone as a flux.—At the only iron works now carried on in the Province, viz: the Acadia Iron Works, Londonderry, limestone from the neighbourhood is employed. When the Nictaux works were in operation limestone was imported from New Brunswick to a port on the Bay of Fundy and thence conveyed by land carriage some eleven miles to the furnace. The importance of having a supply of this rock near the works is seen by observing the amount employed. In 1861 the quantity of iron made at Londonderry was 1,200 tons, and Mr. Jones, the manager, stated (see these Notes, Part I), that 200 bushels of limestone were required to smelt one ton of ore, so at that time there was a consumption of 240,000 bushels of limestone, a quantity more than two-thirds greater than that of all the lime burned in the same year throughout the Province,

Marbles.—These have been long known to exist in various localities but none of them have been worked, an attempt having been made at one place only to make use of a deposit. A fair representation of the varieties best known was made at the International Exhibition of 1862*, when there were shown thirteen specimens from eleven localities.

Parrsboro' yields a purplish coloured marble with green spots of serpentine. *Onslow* mountains furnish a chocolate and a red variety, Cheverie a reddish brown with red bands. Pictou Co., affords

*Want of time prevented as good a representation at the Dublin Exhibition.

several kinds: one of a greenish hue, and among the rest one which is very remarkable. It is of a grey colour and when polished shows concentric waved bands covering the entire surface in beautiful markings. The specimen exhibited had perhaps a square foot of surface and was due to the liberality of Messrs. Wesley & Sanford, who also polished some of the other marbles shown. So far as I know this marble is unique and if it should be found in large slabs of the same character as that which was shewn and excited so much admiration there can be no doubt it would be very profitable. Even in small slabs it would be probably prized for inlaying. Cape Breton has large deposits, there are known a white marble with blackish veins, a black with white veins, and a white and deep green variety, which is very handsome. All the specimens at present met with are from the surface. The deposit of marble which is best known is that at Five Islands, in the Basin of Mines, where it forms large beds in the metamorphic rocks; the marble is of excellent grain and of a fine white colour, surpassing in beauty, when polished, according to Messrs. Wesley and Sanford, the Italian Marble. It is this which has been to some extent tried as to its value. About 1852 a gentleman was sent from England with two quarrymen to get out a block. He remained for some months and finally shipped a block of considerable size at an expense, it is said, of about £1,000. The explorer is reported to have stated that the marble was superior to any he had seen from Carrara, but on the arrival of the block in England it was pronounced unserviceable from being shattered. This condition of the specimen is considered to have been due, at all events in part, to the block having been got out by blasting, so that this trial may not have determined the real value of the deposit, and I have also heard from a resident in the neighbourhood at the time of quarrying, that more might have been done at the same expense. Even if larger and better conducted operations do not show that large masses can be got out, at least it is probable that smaller blocks suitable for busts and statuettes may be obtained.

A material may be mentioned here which may prove, under certain circumstances, a useful substitute for marble, viz: the hard plaster or anhydrite, which is found abundantly, and could probably be obtained in blocks of any useful dimensions. It occurs at Falmouth and St. Croix of a white colour, at Windsor of a bluish tint

and also a mottled white ; at Parrsboro' a purple rock is met with and no doubt it presents other varieties elsewhere. Its greatly superior hardness at once distinguishes it from the ordinary plaster, It is used in this neighborhood (Windsor), in building the foundations of houses. At the International Exhibition two specimens of the Windsor hard plaster were shown cut and polished: one gave a finely clouded surface and the other was rather uniformly spotted; both were grey, and one showed in some lights a slightly bluish tint: the edges of both at the meeting of the polished surfaces were remarkably sharp and perfect. Since sulphate of lime (the chemical name of plaster) is not insoluble in water, polished surfaces of hard plaster would lose their lustre in the open air, and the material can only be used when cut and polished in in-door work; under these circumstances it may prove more durable than marble, which is said to be so subject to change from variations of temperature that the mantle of a chimney piece immediately over the fire is invariably in a crumbling condition long before the sides or those parts which are not so exposed to heat. This statement is given in Hunt's Hand-Book to the International Exhibition (Vol. I, p. 325), and we find there also (p. 332) in a very interesting passage, that some alabaster, a variety of *soft* plaster, is more durable than Purbeck marble. The author says "notwithstanding alabaster is decidedly so soft a substance that it may be easily cut with a pocket-knife, or abraded with the nail, it is nevertheless an extremely durable material, if not openly exposed to the weather. In most of the large churches in the south of England, especially in Westminster Abbey, there are instances of monuments constructed with Purbeck marble, and ornamented with alabaster tracery, niches, canopies, and little figures, which are almost without exception perfectly free from decay; angles sharp, surface smooth, colour scarcely altered; while the Purbeck, a harder material, upon which the alabaster is fixed, has scarcely any of the original surface left: although these two substances are close together, equally exposed to the same atmospheric influences of damp and dry, summer and winter, from the fifteenth or sixteenth century, to the present time, yet one is apparently unaltered, while the other is certainly perishing, disintegrating, and gradually mouldering away."

Having been led to the subject of alabaster, I may state that the

compact gypsum of Antigonish has quite the character of alabaster. I have only seen small pieces but probably larger ones are to be got. The quality of this as a material for carving was shown at the Dublin Exhibition, it proved excellent. A small piece was carved to represent a bunch of grapes and some leaves by Mr. C. Harding, of Windsor, whose skill and taste in another department of fine art, viz : pen and ink drawing, have contributed materially to the adornment of the Nova Scotian Courts in both the late Exhibitions. It came under my own notice that both the carving and the material, attracted the attention of a wood-carver and called forth the expression of his favourable opinion.

In the Provincial Building now being erected, an opportunity offers for testing the value of native materials in internal decoration, and perhaps the public voice will be heard in favor of embracing it as the matter is surely one of Provincial interest.

Art. VIII. Remarks on the Pitch Lake of Trinidad. By Rev John Morton, LaHave.

[*Read March* 8, 1866.]

The Pitch Lake of Trinidad lies on the western side of the island and about a mile from the Gulf of Paria. It is nearly circular, and about three-fourths of a mile across. There is no point from which a view of the whole lake may be obtained, as it is broken in upon by islands and obtruding points. These lie principally about 400 yards from the western side of the lake ; and from these the view easterly is very striking, and relieves the disappointment which is generally felt upon the first view of the lake. The expression *lake* is apt at first to mislead. The pitch is not in a fluid state, except in a very small spot, and may be safely walked upon over all the rest of the lake. Indeed teams might be driven over a great part of it, although any heavy weight left on it would gradually sink. The pitch, which from the heat of the sun and probably also from subterranean fire, is hot all over the lake, becomes hotter as you approach a point near the centre, where it is simmering and boiling over very gently. You can safely advance to the very edge

of this spring and obtain a specimen, care being taken not to burn the fingers.

The surface of the lake is intersected by little canals, particularly on the western side. Some of these are shallow and narrow, others are three or four yards wide and from three to five feet deep. The edges of these canals are rounded like the lips of an ancient urn. And they seem to have been formed by the pitch, which had boiled over from different springs, having met and cooled. Where the springs have been near each other the overflowings have run together, so that their meeting can scarcely be traced. But where they have been more distant the pitch waves have had time to cool somewhat before meeting, and thus hardened have met at the bottom without running into each other, and the interval between their edges forms a deep canal, wide at the surface and rounding down to a crack at the bottom, where the overflowings have met. Lips more or less gently closed may serve to illustrate the shape and varieties of these canals. They are always full of water. We enjoyed a tepid bath in some of the deepest and found them of the same shape as the others. None of these canals intersect each other; but where overflowings from three different springs have met, three canals are formed, deepening in their course until they converge into a deep triangular pool. The pitch does not always boil at the same part of the lake, nor always with the same activity. And these overflowings point to a time when the pitch springs have been near the western side of the lake, and perhaps more than one of them active at the same time.

The western side has a shore or border of pitch, sloping more or less gently towards the lake, indicating a depression in its level. The eastern side presents a different appearance. Here the soil covered with grass and bushes comes close to the lake. The lake itself is smooth, and the canals on its surface few and small, indicating a greater internal heat. At the edge of the lake the soil is only a few inches deep, and the land is very level, and seems really a continuation of the lake with a superjacent shallow layer of earth. This is confirmed by appearances further inland, where the formation can be traced for about six miles. If, as we conjecture, the land here rests, for some little distance, upon the pitch in a soft and but little inspissated condition, it is easily seen that on a subsi-

dence of the lake, the land floating upon it would subside with it, without altering the appearance on the surface. Whereas on the western side, the solid formation adjoining the lake would hold its position, and thus indicate the subsidence of the lake in a shore such as that to which we have referred.

From the western side of the lake, the land descends without interruption to the Gulf of Paria. In this slope there is a very gentle depression, beginning where the shore of the lake is least elevated, and where it appears even now almost ready to overflow, and traceable to the Gulf, where the pitch is found exposed along the shore, and forms a point that stretches into the Gulf about 400 yards. Here the appearances are of a nature not to be misunderstood. The pitch is exposed for about a quarter of a mile along the shore, and in some places for several rods above high water mark. And it is clear that it has not been thrown up by the tide, as some have asserted, but has flowed from inland. The flowings are as distinctly marked as if they had occurred but yesterday. The manner in which they have been turned aside by obstructions and their uniform slant, together with the clearly marked edge where the flowing has cooled, admit of no doubt in this matter. In the bight formed by the point of pitch which juts out into the Gulf, the beach is wholly of pitch; it is very steep and has the rounded contour of the edge of a large pitch wave, as if it had been here arrested in its progress and cooled by the tide. Southerly from the point of pitch the beach becomes more level, and is covered with black pebbles, in some places to the depth of a foot. These on examination prove to be pitch and scoria rounded by the action of the tide. Passing on we find a well defined flowing that seems to have hardened before it reached the tide. Here the land rises abruptly, the beach becomes sandy, and we lose all traces of the pitch.

A public road enables us to trace the formation up the depression of which we have spoken, the whole way to the lake. In some places several feet of soil overlie it, but as you approach the lake the soil becomes shallow and has been washed from the road by summer rains, leaving the pitch quite exposed for a considerable distance. All along the road and particularly where the pitch is thus extensively exposed, the hardened overflowings are as well defined as on the shore. Their appearance is well illustrated by what

may be seen on many hill sides during our Nova Scotian winter, where water has congealed in successive overflowings. The conclusion is inevitable, that the Pitch Lake has been, and is still to some extent, an immense Pitch spring or series of springs, and that the depression from the western side of it to the shore of the Gulf of Paria, is the bed down which the products of this vast spring has at one time flowed, causing the appearances on the road and on the shore, and pressing out into the Gulf has formed the point of pitch above referred to.

I have not been in a position to consult any standard geological works on the subject except Sir Charles Lyell's. And as my object was not to compose a scientific essay, but merely to accompany the specimens with a few remarks, I have confined myself to the result of my own observations.

Sir Charles' works contain little on the subject. In his "Principles" (p. 250, 9th ed.) he says:

"Fluid bitumen is seen to ooze from the bottom of the sea, on both sides of the island of Trinidad, and to rise up to the surface of the water. Near Cape La Braye there is a vortex which, in stormy weather, according to Capt. Mallet, gushes out, raising the water five or six feet, and covers the surface for a considerable space with petroleum, or tar; and the same author quotes Gumilla as stating in his 'Description of the Orinoco,' that about seventy years ago, a spot of land on the western side of Trinidad, near half-way between the capital and an Indian village, sank suddenly and was immediately replaced by a small lake of pitch, to the great terror of the inhabitants."

"It is probable," says Sir Charles in continuation, "that the great pitch lake of Trinidad owes its origin to a similar cause."

When on the spot I was not aware that such statements had been published, and consequently made no special enquiry about them. But I never heard anything corroborative of them, except that bitumen was sometimes seen in small quantities floating near La Brea. Such a *vortex* as Capt. Mallet speaks of would be too notorious to be overlooked by persons living there, when answering the enquiries of strangers respecting the wonders of the place. Nor did I ever hear of *a small pitch lake,* such as Gumilla speaks of. His location

of it is very indefinite, and points as much to the great pitch lake, as to any place on the whole western coast.

The town of San Fernando, is about twenty miles N. of LaBrea. A hill rises abruptly, behind the town, to the height of upwards of 1000 feet. The cutting of a road, across a spur at the north side of this hill, lays bare a surface of pitch. It is very hard and has the appearance of having been thrown out of place by some convulsion. The valley of the Naparima, extending inland some nine miles and about four miles in breadth, is well cultivated, and a tramway runs up through it, in laying which several considerable cuttings have been made, but no pitch has been any where discovered. From this and from the fact that there are decided indications of volcanic action on the hill, it seems probable, that the pitch has been here thrown up from a considerable depth, by volcanic action; and that the formation extends over a considerable part of the W. side of the island, from the middle to the southern ranges of mountains, flowing out at LaBrea, underlying the surface further north, and thrown up by volcanic action at San Fernando Hill. All this part of the island is subject to volcanic action. At Pointa Pierre six miles N. of San Fernando, there are hot springs; and in the forest twelve miles east, I visited some small but very interesting and active mud volcanoes.

Near the southern range of mountains, sulphur has been found almost in a pure state, reminding one of a similar connection of pitch and brimstone at the Lacus Asphaltides, under which the slime pits, or bitumen wells, of the Valley of Siddim, continue to throw up their products, and on whose shore brimstone is found in large quantities.

The pitch of Trinidad is manufactured on the Island, with common coal, and then used for raising steam. M. Stollmeyer, is largely engaged in manufacturing it for paving, or flooring stores; it being preferable to wood where insects are so troublesome and destructive. But it is scarcely hard enough for paving streets in so hot a climate. It is largely shipped to France and Hamburg, for paving. The pitch for shipment, is raised at the point that runs out into the Gulf of Paria, whence it is conveyed in boats to vessels anchored a few hundred yards off. The pitch here, being more inspissated than at the lake, is better adapted for conveyance in large

quantities. Much of the pitch manufactured on the island is taken from the lake. When thrown into heaps it runs together into a solid mass. And the place from which it is taken, although near the side of the lake where the pitch is hardest, gradually fills up again by the pressing in of the surrounding mass. The supply being so large and so easily attainable, it must continue for ages of vast economic importance.

Art. IX. On some Recent Improvements in the Amalgamation Process for Extracting Gold from Quartz. By George Lawson, Ph. D., L. L. D., *Professor of Chemistry, Dalhousie College.*

[*Read March* 8, 1866.]

The paper was chiefly occupied with a discussion of the properties of the metal Sodium, (Na.) and of the Sodium Amalgams, and of the use of the latter in promoting the amalgamation of Gold.

The metal sodium, a discovery of Sir Humphrey Davy, was particularly described, and the method of removing it from its combination with oxygen. It was prepared by decomposing carbonate of soda by means of charcoal, at a high temperature, this last having a greater affinity for oxygen than sodium. The use of sodium in the arts has so diminished its price that it can now be obtained at 6s. stg. per lb. Specimens of large size, contained in naphtha, were exhibited. Its colour is silver white, sp. gr. 0.972—it is as soft as butter at the ordinary temperature of the atmosphere, fuses at 194°, and oxidizes rapidly in air. It burns on a slight increase of temperature. Several interesting experiments of its fusion and burning were exhibited. It decomposes water rapidly, uniting with the oxygen it contains, and liberating the hydrogen. The Doctor illustrated its action on water by some beautiful experiments,—amongst others, by the preparation in course of a few minutes of a large jar of hydrogen gas, by the action of sodium upon water; the hydrogen was afterwards exploded to show the converse of the experiment. The property of sodium in promoting the action of mercury and amalgams upon other metals had been known for many years. Recently, however, Mr. Crooke, F.R.S., a distinguished chemist, who had discovered the metal thallium, has applied sodium

to the purpose of gold amalgamation. The Doctor here explained the ordinary process of separating the gold from the quartz, by using mercury alone, a process which was often inefficient, owing to the presence of sulphides, which, coating the gold, prevented the action of the mercury upon it. It was found by Mr. Crooke, that by combining the sodium with mercury, an amalgam was formed that had much greater power of taking up gold than mercury alone. By means of a sand bath and a glass vessel, the experiment of combining the mercury and sodium was shown to the meeting, and a considerable piece of amalgam made with the requisite proportions of mercury and sodium; and the action of the amalgam so made was shown on thin slips of gold freshly annealed, from the Waverley mines. It was shown that these slips of gold were not at all affected when drawn through ordinary mercury; but the moment they came into contact, however slight with mercury to which some of the sodium amalgam had been added, they were completely and permanently coated with mercury. The following was the account given of Mr. Crooke's process, which had been fully investigated by an extensive series of experiments in Professor Lawson's laboratory, and so favourably reported upon that a patent has been granted:—

"This invention relates to certain improvements in the method of treating the ores or substances containing gold and silver by amalgamation, and whereby those metals can be more perfectly and completely extracted and separated therefrom, than by the processes hitherto adopted. A solid amalgam of sodium is in the first place formed by combining about one part of sodium with about thirty parts by weight of mercury. The solid amalgam thus formed is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantity of metal contained and the state in which it occurs in the ore or matrix. If however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid and its manipulation inconvenient. The effect of thus combining the sodium with the mercury, is to impart to the latter a greater affinity for or power of adhesion to the metal under treatment, than it possesses in its simple and uncombined condition. Instead of using the solid amalgam as hereinbefore mentioned, the sodium may

be combined directly with the mercury employed, the proportions varying according to the requirements of the case.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and in cases where amalgamating vessels or receptacles constructed of iron are employed, an additional advantage arises from the fact that mercury combined as before mentioned with sodium forms a thin film over the surface of the iron, thus collecting very minute quantities of the metal under treatment, and which may be removed by the ordinary process, and subjected to the subsequent treatment usually employed.

"The mode of treatment employed is as follows :—An amalgam of sodium is in the first place formed by combining sodium with mercury. The proportions may be varied within wide limits, that is to say, from less than three to more than thirty parts of sodium to one hundred parts by weight of mercury. The sodium and mercury must be caused to unite, and the amalgam prepared with the customary precautions well known to and understood by chemists. The last mentioned method of forming the sodium amalgam is that which the inventor usually prefers in actual practice ; but, if desired, the amalgam may be prepared electro-chemically, as described by Becquerel and other chemical authors, or by any other suitable means. The amalgam is then added to the mercury employed for the purposes of amalgamation, the proportions varying according to the quantities of precious metal contained, and the state in which it occurs in the ore or matrix ; but as in the process the beneficial effects of the sodium are gradually removed, the action should be maintained, if needed, by occasionally introducing fresh supplies of the amalgam into the charge of mercury contained in the machine employed. The quantity must, however, be regulated and determined by the skill and judgment of the operator, as no definite and absolute proportion can be laid down as necessary. If, however, the proportion of the alkali metal exceeds that of one part to from 120 to 150 parts of mercury, the amalgam becomes viscid, and its manipulation may be inconvenient. The effect of thus combining the sodium with the mercury is to impart to the latter a greater affinity for or power of adhesion to the precious metal under treatment than it possesses in its simple and uncombined condition, so that it will readily amalgamate with the gold or silver, even when

the latter metals are soiled by grease or other extraneous matter. Although he prefers that the amalgamation shall be conducted in the presence of water, as in the usual processes, the operation, if desirable, may be performed in a dry manner. The amalgam above mentioned should be stored in air-tight vessels, or under naphtha, such as metallic sodium is usually kept in. Instead of using the amalgam as hereinbefore mentioned, the sodium may be combined directly with the mercury employed, care being taken that the proportions shall remain substantially as already indicated.

"This invention can be used in conjunction with any machine or apparatus for performing the amalgamating process, and, in cases where amalgamating vessels, or receptacles or places constructed of iron or other metal are employed, an additional advantage arises from the fact that the mercury combined as before mentioned with sodium forms a thin film over the surface of the iron or other metal, thus aiding in the collection of any minute quantities of the precious metal under treatment. The subsequent extraction of the gold or silver from the mercury may be conducted in any desirable manner. It is not found in actual practice that a small quantity of sodium, if accidentally allowed to remain in the mixture with the gold or silver and mercury, affects the subsequent treatment in any appreciable degree. In cases where, from the nature of the ores or substances under treatment, the mercury used for amalgamation becomes divided into minute globules, technically known as "flouring" or "granulating," there is frequently a difficulty in separating the globules from the heavy particles of the powdered ore or substances containing the precious metal; the addition of the sodium amalgam to such a mixture is found to induce the coalescence of the liquid or viscid metallic particles, so that a mechanical separation of the gold or silver amalgam from the gangue may be readily effected. The employment of sodium in combination with mercury will especially be found beneficial in cases where gold or silver occurs with pyrites, sulphurets or minerals containing arsenic, antimony, tellurium, or bismuth. The process of amalgamation with ordinary mercury is difficult to perform in the presence of such minerals without great loss both of mercury and of the precious metal under treatment, owing to the surfaces of the latter being in such a tarnished or soiled state that mercury

alone will not touch them (as, for instance, when gold exists in pyrites). and also owing to the mercury becoming what is technically termed "sick" or "floured," in which state its power of uniting with the precious metals is much diminished; in these cases the addition of sodium amalgam will be found highly advantageous; whenever the mercury has become "floured" or powdered by the result of distillation, or from any other cause, it is readily restored to the liquid or bright metallic state by the addition thereto of sodium, either in its simple metallic condition, or as an amalgam with mercury.

"Although sodium is mentioned as used in the processes above described, other alkali metals, such as potassium and lithium and other metals strictly analogous thereto in their chemical and physical characters, may be employed in lieu thereof in combination with mercury for the purposes of this invention.

"Having thus fully declared and ascertained the nature of his invention, and the manner in which it is to be performed, Mr. Crooke claims that what he considers novel and original, and therefore as constituting his said invention, is, the employment of an amalgam of sodium, or such other alkali metal as aforesaid, in treating ores or substances containing gold or silver for the extraction and separation therefrom of the precious metals, as hereinbefore substantially set forth and described."

Dr. Lawson, then explained the simplest methods by which chlorine and hypochlorous acid might be generated for sanitary purposes; and Mr. Outram described the process of manufacture of chloride of lime as conducted in the great works at Glasgow.

6th September, 1866.

P.S.—Professor Lawson has requested the Secretary of the Institute, to insert the following memorandum of some further results in regard to Mr. Crooke's Process, which is now coming into use in our Gold Mines:—

"Experiments have lately been undertaken at the Lake Major Company's Mines, Waverley, with the view of testing in a practical manner the value, or otherwise, of Crooke's new process of amalgamation by means of sodium-amalgam. The crusher and other machinery of these mines being much superior to those of any simi-

lar establishment in the Province, the best opportunities have been afforded for a fair trial. The experiments have been carried out by Dr. Krackowizer, the manager of the mines, in conjunction with Prof. Lawson of Dalhousie College, whose laboratory investigations of the process were detailed sometime ago to the Institute of Natural Science. The results are highly satisfactory, and fully confirm the favourable opinion that has been formed of Crooke's process, and of its adaptability to Nova Scotian ores. One great advantage of the process is the action of the sodium amalgam upon pyrites, which material abounds in our quartz veins and is known to contain gold, but has hitherto been accumulating around the mines in enormous quantities as a waste material. A portion of this material operated upon by the new process gave at the rate of 5 *ounces of gold per ton of pyrites.* This is regarded as a remarkable result, and one that will certainly lead to the profitable extraction of gold from pyrites, especially as no extra apparatus is needed such as would be necessary for the chlorine process."

No. X. On the Food Fishes of Nova Scotia. No. IV. The Trouts and Salmons. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.,

[*Read April* 2, 1866.]

I have identified five species of the genus *Salmo,* as inhabiting the fresh and sea waters of this Province. They all closely resemble each other, in their powerful tail, and strong muscular back, their armature of numerous and recurved teeth, their tendency in the young to vertical markings, and the most of them to spots,—by all having the false or internal opercle as noticed by Muller,—by all spawning in November,—and all requiring highly ærated water in which to deposit their ova, thus seeking shallow streams of swift running water,—by hunting for their food singly, or in small numbers,—by a common voracity, and boldness, all with one exception having the power of throwing themselves several feet above the surface of the water,—by all seemingly enjoying life, and parting with it by fierce struggles—this last making them game-fish,—and lastly, by all of them being marked by a fatty fin, without rays, a typical mark whose use we cannot explain, and which they share with the very kindred geni of *Corregonus,* and *Thymallus.*

In identifying *S. Salar*, (Lin.), *S. Fontinalis*, (Mitch.), *S. Canadensis*, (Ham. Smith), *S. Gloverii*, (Girard), *S. Confinis*, (DeKay), and attributing them to their rightful first describers, I have met with much difficulty. The principal writers seem to have had no personal knowledge themselves of the fish in question, whilst the best observers seem to have wanted what the first gentleman had, a scientific tact and skill of observation. Thus Perley, followed by Frank Forrester, has confounded *S. Canadensis* with *S. Trutta* of Europe, and *S. Gloverii* and *S. Confinis*, with *S. Ferox*, also European. I need scarcely say how soon Yarrel, or "Couch's British Fishes" would correct this error. In the present paper I have only given facts that I have identified myself, or that have been told me by local observers. The works I have referred to are those of Richardson, Dekay, Storer, Gill, Norris, Frank Forrester, "*Game Fish of the North*," Perley, and manuscript correspondence of F.W. Putnam, Esq., Salem, U. S.

Salmo Salar—The Salmon.

The description of a fresh run fish from the ocean, as they appear in spring in our market, would be — weight from six pounds up to twenty, head small, body very deep, and at the same time round or thick through; back very muscular, and tail large and strongly based; the opercle is circular on its outside edge, in this a very marked contrast with the trout, in which it is angular; the free edge of the labial is rounded, whilst the same part in the trout is sharp; the eye rather small and about two and a half diameters from tip of nose; the nostril double, like all the genus; the outline of back rounds up from the head, then runs in nearly a straight line to the first dorsal, which has twelve rays, the first very thick and short, and of an irregular rhomboidal shape; the anterior edge of the second dorsal or adipose fin is opposite the fifth ray of the anal, its posterior edge opposite the last ray; the tail very strong, rays twenty, the anal ten, first very thick, and ventral nine, the pectoral fin rises close to the margin of opercle; the colour fresh from the sea is black along the back, running gradually into steel blue, with green reflections to the line of raised scales, all below of the brightest silver; the head and opercles are, upper half dark blue, lower silvery; the fins, dorsal pale lavender with irregular spots, rays dark blue, adipose blue, caudal base and edges dark, middle pale yellowish white, anal pale yellow; ventral with large accessary fins yellowish; rays and anterior edge dark, pectoral pale bluish white, anterior edge and rays dark blue; on the pre-opercle and opercle are one or two black irregular spots; a number of black blotches occur at irregular intervals along the sides and side of the belly. Teeth on intermaxillary, upper and lower maxillary, palatine bones, in vomer, but not more than two or three, and on tongue about nine or ten around the edges; scales very large Fin rays—D. 12, V. 9, P. 11, A. 9, C. 20, a large axillary scale to V. Gill rays—11 on each side. Posterior edge of opercle round, free end of maxillary round.

Such is a description of this king of fish, as he appears from the ocean. But it gives but a faint conception of the flashing lights thrown back from his sides of molten silver, upon the tender blue of his back, or of the dying but fair lavender of his fins. Filled with the only food upon which he thrives, the ova of various echino dermata, or the flesh of the sand eels, his huge back is swelled out and rounded like a race horse. The flesh itself is tinted red, and fat flakes lie thick in the fibres of every muscle. His courage and strength are equal to his form and colour,—and he has need of them all. A long and weary journey is before him, with scant food and hard toil. He enters our rivers, beginning in March at the most southerly and westward ones, to ascend the lakes to his spawning grounds. Towards the end of June the run at Halifax is over. He buries himself now in our lakes, and for a time nothing is seen of him. On his passage up he takes the fly, and is seen leaping over the natural obstacles or artificial barriers that arrest his progress. From six to eight feet is his utmost perpendicular height. He is often seen lingering in the deep holes of the streams which he is ascending. He becomes lean and thin almost immediately on entering the fresh waters. His flesh loses the lively red tint and exquisite flavor, his silvery sides turn yellow, and his steel blue back a dingy black, reddish diffused patches stain his sides and head and cheek. In the male, changes much more characteristic are stealing over him, the upper jaw lengthens, teeth both more numerous and larger appear; an eagle-like hook is formed; the lower jaw lengthens, curves up, is armed with supplementary teeth, and a nob or hook of gelatinous substance sprouts out of its end, which fits into a hollow of the upper jaw.

On the 10th July, 1865, I noticed many large salmon taken from the fresh water river, Shubenacadie. They had been some time in fresh water, had lost their blue and silver hue, and pink flesh tint, and had also lost their teeth, some of them almost entirely, others partially. Their jaws were arched, the bone evidently absorbed. I was much puzzled to account for so many old fish being taken at once, and only in fresh water, since such fish were never known from the sea. On the 26th November, 1865, M. Brown, Esq., Halifax, sent me a salmon, a male fish, weighing perhaps sixteen pounds, whose head and jaws were so peculiar as to need an exact

description. The intermaxillary articulation was very loose and much enlarged. The intermaxillary bone itself had grown at least two inches in length, formed into a beak like an eagle's, and filled with very large teeth. The lower jaw had also grown to correspond in length, and was also armed with large teeth. A cartilaginous knob projected upwards from the lip, which fitted into a groove above in the intermaxillaries. The new jaws were so arched that it was impossible for them to close in the centre, and the teeth were much larger and with wider bases than the usual teeth. I am now of the opinion that the toothless fish I saw in July were preparing, by losing their original teeth, for this spawning growth, soon to sprout from their denuded jaws, of not only increased osseous matter, but of an entirely new set of teeth, and that the whole of the huge structure in a few months, broken down or worn away by conflicts and by furrowing up the sand and gravel, becomes totally absorbed on reaching the ocean, and is again replaced by the ordinary teeth, thus each male salmon having two sets of teeth during the year.

Towards the latter part of November he is seen frequenting the shallow, sandy bottomed running streams. He is busy furrowing up the gravelly bottom with his lower jaw, in water so shallow that his tail flaps upon the surface. The loitering sportsman often overlook him working up stream so as not to foul his water, and sedulously conducting his mate into the furrow where he impregnates the ova streaming from her teeming sides, or rushing out upon the shoals of young males in clouds about him, each a miniature salmon with hook and bill, though barely six or seven inches long.* The lumberman too is sometimes tempted from his toil by suddenly coming upon a shallow lake literally covered by hundreds if not thousands.† Serious encounters are sometimes instanced between two rival males, the wounds taken and given are often frightful. At the end of the season, an old male thoroughly emaciated, lean, dingy yellow, his jaws literally worn to the bone or hanging in fragments, his body torn into gaping wounds, with his pale blue gleaming eyes, is truly a ghastly form, flitting dark and dull and

*Charles Anderson, Esq., Magistrate, Musquodoboit.

†Mr. John Duncan, Ingraham River, told me that he once with a party of lumbermen, came upon at least a thousand salmon, spawning upon Snake Lake, Halifax County. For every man and teamster to desert his work, and rush into the shallow waters, with axe, or pole, or ox goad, or young sapling, was the work of an instant. Some eight or ten were the only spoils that rewarded their cupidity.

half seen through his watery home. They are now said to return to the sea, principally because we find them there in early spring. This part of his return journey has not so many landmarks about it as I could wish. Indeed some say they remain all winter in the lakes, and no doubt many do. Thus it may be said that the salmon in Nova Scotia have their principal run from the ocean to the lakes in April, May and June—that they spawn in November and immediately return. But this is only generally true. From a number of facts I am led to conclude there is a perpetual passing up and down during the whole summer. On the 20th of May, 1865, I procured from the tide way at Bedford Bridge, five young salmon from six to eight inches long, these I suppose were fry of the ast year, fifteen or sixteen months old, going to the sea for the first time. With the exception of a few vermillion spots upon them, and that the nose was rounded and short, they were true salmon, teeth perfect and some with ova. It is now admitted (from the numerous and conclusive experiments of marking fish) that they visit the ocean and return in a few weeks weighing six to seven pounds, and spawn in November. Successive runs of these fish must be perpetually passing up and down our rivers. In September, female spawning fish, entirely discoloured, and filled with spawn of the size of buck shot, which escapes readily, are exposed in market from the Shubenacadie river, and one would never think they could retain their spawn till November. The year just past was unusually dry and the lakes and streams low. Thus Bedford river, near Halifax, was thronged with fish unable to get up. In November thirty were counted from Flat rock in one deep hole. Our markets have always a run of November salmon taken outside on the ocean, in the highest condition, and which according to Col. Hardy, have the ova very small and undeveloped. Thus at one point of time we have three sets of fish, one spawning or spawned in the lakes, one running up, and a third ranging the ocean unimpregnated. From these facts we must deduce that there are modifications perpetually occurring to vary within certain limits any general law. On his passage he readily takes the fly, during his sojourn in the lakes not; though of these facts I am not quite certain. In the ocean we find him a deep feeder, his food being said to be the spawn of various fish, and he is often taken by bait fishing on our coast some distance from shore, and at about sixty

or seventy fathoms. There can be little doubt that he also feeds upon smaller living fishes as well as flies and larva.

One must witness a score or two of these fine fish for sale in the Halifax fish market dripping fresh from the ocean, before they can truly appreciate their magnificent proportions, their great depth and thickness, and great round backs swelling into so massive a foundation for their huge tails,—the clear silver laced with blue of the sides, the opal tints flickering around their bellies, or the fleeting lavender of their fast stiffening fins. Those figured by Yarrell and Couch, by Dekay, and even Agassiz, a Halifax fisherman would not allow upon his stall. The extreme length and want of depth would condemn it at once as a spent fish. Of the many stories of marvellous captures of these fish, the best and certainly the truest is the following, which happened in my own time and neighborhood:—Mr. Baillie, grandson of the "Old Frontier Missionary," was fishing the "General Bridge river" up stream for trout, standing above his knees in water with an old negro named Peter Prince at his elbow. In the very act of casting a trout fly, he saw, as is very usual for them, a large salmon lingering in a deep hole a few yards from him. The sun favored him, throwing his shadow behind. To remain motionless, to pull out a spare hook and pen knife, and with a bit of his old hat, and some of the grey old negro's wool to make a salmon fly, then and there, he and the negro standing in the running stream like statues, and presently to land a fine salmon was the work of but a few moments. This fly must have been the original of Norris's killing "silver gray."

Salmo Fontinalis—Mitchell—Brook Trout.

The description of this fish as usually seen in the lakes about Halifax, would be—in length from ten to eighteen inches, and weight from half a pound to two pounds—though these measurements are often exceeded or lessened. The outline of back starting from a rather round and blunt nose rises gradually to the insertion of the dorsal fin, about two lengths of the head from the nose; it then gradually declines to the adipose fin, about a length and a half from that runs straight to form a strong base for the tail. The breadth of the tail is about equal to the length of the head. Below, the outline runs nearly straight from the tail to the anal fin, from thence it falls rapidly to form a line more or less convex (as the fish is in or out of season), and returns to the head. The intermaxillary very short, the maxillary long with the free end sharp pointed, the posterior end of the opercle is more angular than in the the *S. Salar*, the lower jaw shorter than upper when closed,—appearing longer when open.

The eye large, about two diameters from tip of nose; nostrils double, nearer the snout than the eye Of the fins, the dorsal has ten or eleven rays, not counting the rudimentary ones, in shape irregularly rhomboid but the free edge rounded or curved outward, the adipose fin varies, some sickle shaped with free end very long, others having it very straight and short. The caudal fin gently curved rather than cleft, but differing in individuals. Of the lower fins, they all have the first ray very thick and flat, and always faced white with a black edge, the other rays more or less red. The head is blunt and back rounded when looked down upon. The teeth are upon the intermaxillary bone, maxillary bones, the palatine, and about nine on the tongue. There are none so called vomerine teeth, though now and then we find one tooth behind the arch of the palate, where they are sometimes irregularly bunched together. The colour varies but through all the variations there are forms of colour that always persistent must be regarded as typical. There are always vermillion spots on the sides, there are always other spots, sometimes decided in outline, in others diffused into dapples—but always present. The caudal and dorsal fins are always spotted and of the prevailing hue of the body. The lower fins have always broad white edges lined with black and colored, with some modification of red. The chin and upper part of the belly is always white. With these permanent markings, the body colour varies from horn colour, greenish, grey, blue grey running into azure, black, and black with warm red on the lower parts, dark green with bright yellow lower parts, and lastly in young fish, vertical bands of dusky black. The spots are very bright and distinct when in high condition or spawning, faint, diffused and running into dapples when in poor condition. Of four trout purchased from a negro woman at Halifax, Oct. 28, 1864, during the spawning season, three were dark green, bright yellow spots, bright yellow bellies, dorsal fin spotted black on yellow ground, caudal spotted black on scarlet ground; lower fins scarlet with white facings lined with black. The fourth was nearly black above washed with red, the red becoming exceedingly vivid on the belly, all the fins bright scarlet marked as the others, spots bright scarlet—all had white chins, and stripe on the belly white, spots in all very small and vermillion specs in all, all the hues were most vivid and heightened by profuse nacre. This may be considered the colour in the highest condition. In others, the spots are very pale yellowish white and running on the back into vermicular lines, the irides in all dark brown. I have seen the rose or red coloured ones at all times of the year. The young of the first year are green horn colour, with brown vertical stripes and bright scarlet fins, and tail already showing the typical markings and spots, and also the vermillion specs. Fin rays D. 13, P. 13, V. 8, A. 10, Gill rays, 12. Scales very small; dorsal has two rudimentary rays, ten or eleven long ones, varying in different fish. Typical marks, axillary plate nearly obsolete—free end of maxillary sharp, bars in young, vermillion specs, both young and adult lower fins red with white and black edge.

Unlike the salmon who is always a stranger, this beautiful fish is a favorite with all. He is with us the whole year, in large lakes, in brooks, in tiny rills were the young lurk for security, and even in the tide waters, to which he will always resort if in his power. In June, 1866, I saw some of exceeding beauty and colouring taken from the tide waters of Digby basin. At the outlet or inlet of some

still water is his favorite resort, where poised on ever fanning fin he awaits his food. Whoever has had the privilege of lying at full length on a mossy bank and watching him in his lair—an old root or a tiny cave washed from the overhanging clay banks of the swift running waters, will agree with Agassiz*—"that a true figure of him has yet to be done." Head elevated at a slight angle, his capacious gills opening and closing, round mouth half open, and great round head and speckled and spotted back, overhung by the spotted dorsal hanging athwart, and throwing wavy circles off from every point, his gaudy scarlet tail and lower fins all tremulous, there he awaits his prey, be it an idle fly touching the surface, a larva coming down stream, or a venturous young perch. No spotted pard makes a fiercer rush than this marine tiger, on his quarry. The perch, if he is an ender (coming towards him), disappears at once, or the fly is snapped with an unerring precision. The true figure which yet has to be drawn must make him with a luminous brown eye, round in head and back, the dorsal hanging loose across his back and half elevated and floating watery circles from every point. The pectoral and ventral extended in parallel lines at nearly a right angle from the body and ever fanning—a double pair of propellers, the anal trembling through all its line, and the huge tail vibrating, every ray loose and every membrane floating. The ordinary plates make every fin stretched and rigid, and the pectoral always thrown back upon the side. In October and November he leaves the deep waters for the spawning shallows. In winter he is taken by bait through the ice. Of his muscular power in runningup rapids, Dr. Fisk, of St. John, N. B., an accomplished sportsman, informed me that once fishing the upper waters of the Miramichi he saw trout repeatedly rush up a perpendicular fall of water about six feet, then pause, tremble violently all over, and in a moment throw themselves clear of the stream and fall into the basin above, about four more feet. Many assert this is done by bringing head and tail together, but in the simple terms of an eye witness, a "trembling" was all he could perceive, which no doubt was all that was to be observed.

Six pounds is the largest weight of any trout taken in this Province to my knowledge, two and three pound fish always attract attention. I have never seen one myself four pounds. The colour

*Fishes of Lake Superior, 1850

of his flesh varies from red to pink, and pale yellowish white. Inferior in taste to salmon, it is only prized by those who cannot get the sea-board fish, yet it tastes very savoury roasted and eaten ten minutes after swimming in the cool waters, from a sharp pointed stick stuck around a camp-fire.

Salmo Canadensis—HAMILTON SMITH.

In early spring there is taken by gill nets or by fly fishing about Halifax, a sea trout. The tide water mouths of the various rivers are its favorite resort. In these waters he remains till August, sometimes running up the rivers with the tide a few miles, then again running sea-ward. A very gaudy fly will tempt him out of cover, in the thick tangled kelpy marine forests. Again he is found lurking in the up river deep holes of our turbulent streams. After August he is never found. This is the Trutta of Perley and Frank Forrester, confounding it with the English species. This is the salmon trout of "*The Game Fish of the North*," whose author identifies it with *S. Fontinalis;* and also this is the *S. Canadensis* of Hamilton Smith, in Griffith's Cuvier, as given in Dekay and Norris's *American Angler*. The question has been still more complicated by the brook trout running to sea, which they are always fond of, and thus being classed as sea trout.

On 26th May, 1864, Mr. John Butler, Bedford Hotel, gave me two taken from tide water. June 18th, J. Willis, Esq., gave me one from Cole Harbour, and during July I examined some dozen from Musquodoboit, and finally Wm. Silver, Esq., Halifax, gave me one in Sept. from the fresh water, the rest were from the tide water.

The description of these fish would be thus: of those from the tide way, length from twelve to fourteen inches, deepest breadth, something more than one quarter from tip of nose to insertion of tail. The outline rounds up rather suddenly from a small and arched head to insertion of dorsal, slopes quickly but gently to adipose fin, then runs straight to insertion of caudal, tail gently curved rather than cleft, lower line straight to anal, then falling rather rapidly to make a very convex line for belly and ending at the gills. The body deeper and more compressed than the brook trout. The dorsal is quadrangular, the

NOTE.—Wm. C. Silver, Esq., gave me a trout Sept. 29, 1866, taken on his own grounds, weighing about two pounds, fifteen and a half inches long, entire depth five and a half inches. This was a male fish, milt well developed. The intermaxillary enlarged and armed with larger teeth having a notch in it to receive the lower jaw, also lengthened and hooked. These changes altered the profile of the fish giving him a pointed nose. The colour was most brilliant, the belly tints carmine and the sides of the tenderest azure. The lower fins and lower edge of tail had the broad white and black anterior rays very well developed.

free edge convex, the lower fins having the first rays in each thicker and flatter like the brook trout. The adipose fin varies, some with very long and arched free end, in others small and straight. The specimen from the fresh water was very much longer and thinner, and head proportionally larger. The colour of those from the tideway was more or less dark greenish blue on back shading to ash blue and white below, lips edged with dusky. They all had faint cream coloured spots, both above and below the lateral line, with one exception they all had vermillion specks, but some only one of a side, others two or three. The head in all greenish horn colour. The colour of the fins in pectoral, ventral and anal, varied from pale white, blueish white to pale orange, with a dusky streak on different individuals. Dorsal dusky with faint spots, and caudal with dusky tips, on some a little orange wash. The lower fins had the first ray flat and white and edged with dusky. In two specimens the entire fish was spotted with minute black spots on every part, save the fins where the spots were red, but I considered these to be diseased fish. I leave it to better pens than my own to describe the glorious colouring of this fish dripping from the ocean. The fair green vying with the tender blue of the head and back, the silver of the sides, the lovely pink flesh showing through the silver of the belly, and the catching reflections crossing everywhere. In the specimen taken 10th Sept. from the fresh water, the blue and silver had disappeared, and dingy ash colour had spread down below the lateral line; the greenish horn colour had spread itself over the whole gills except the chin, which was white. The silvery reflections were all gone, the cream coloured dapples were much more decided in colour and shape, and the vermillion specks very numerous. The fins, the caudal and all the lower fins had an orange wash, the dorsal dusky yellow with black spots, the lower fins retaining the white flat ray with a dusky edging—and the caudal a few spots.

The teeth of all were upon the intermaxillary, maxillaries, palatine and on the tongue, none on vomer except now and then one tooth behind the arch of palate.

Fin rays, D. 13, P. 13, V. 8, A. 10. Gill rays 12. Axillary scale very small. Dorsal with two rudimentary rays, ten or eleven long ones, free edge convex, first ray lower fins flat, scales very small but rather larger than brook trout.

The weight of this fish goes as high as seven pounds, their general average is about two pounds. The flavor of their flesh exceeds salmon when fresh, salted or pickled it is very dry. I have said before that from May till August he is taken in our tide waters, both in the Bay of Fundy and along our Atlantic sea board and at Cape Breton. After August he is found in the lakes and streams. C. Anderson, Esq., magistrate, informs me he has taken them during winter through the ice by bait, from one to twenty miles from the salt water, and that he has often seen them returning to the sea in March. Mr. John Duncan, St. Margaret's Bay, is of the same opinion. Wm. C. Silver, Esq., of Halifax, who has studied their habits for years, and in waters running through his own lands, and almost past his

own door, is of opinion that they remain all winter in the fresh water, leaving the tideway in August, that they rapidly change their colour and shape in fresh water, approximate to the brook trout in both, but are always distinguishable.

In classing this fish we must acknowledge it exceedingly closely allied to *Fontinalis*, that it has the teeth, shape of fins, axillary plate, tail, dapples, vermillion specks, spotted dorsal, alike; that when it runs to fresh water, it changes its colour, and in doing this approximates to its red fin and dingy green, and more numerous vermillion specks still more closely. Whilst on the other hand, we find it living apart from *Fontinalis*, pursuing its own laws, attaining a greater size, and returning year after year to the sea. That *Fontinalis* is often found unchanged under the same circumstances. That it always preserves its more arched head, deeper and more compressed body, and perhaps shorter fins. That this has been so for certainly a hundred years, and most probably for thousands, nor have we any evidence that it was at any time not so, except by analogy. In giving it a specific name therefore, and using the appropriate one given it by Col. Hamilton Smith, so far as I can discover, the first describer, I think I will be borne out by all naturalists.

Salmo Gloverii—GIRARD.

Under the misnomer of *Grayling*, a very handsome dark brown trout has long been known to sportsmen as being killed in the lakes about Halifax. The largest were about seventeen to twenty inches long, and weighed two to four pounds. But it was more celebrated for its courage and game qualities, one of half-pound weight giving better sport than a salmon of six or eight pounds; they are often known to spring six feet out of water, three or four times in succession, when struck; they are taken by bait also, being greedy feeders. That they approach the shallow water, and spawn in November, and at other seasons, may be taken the whole year in the deep waters, being lake trout,—and that their young are taken during summer, in the margins of our lakes, having the red spots and tendency to

NOTE.—*S. Imaculata*, of Storer, with large scales, very large axillary plate, larger pre-opercle, is not to be confounded with this species. It is a more Northern species, and not taken in our waters. The dorsal is concave instead of convex. I have examined hundreds, but they were all pickled and from Labrador. The very large ones had no spots of vermil, but the smaller ones all had. In other respects Storer is correct. His description is based on one specimen.

vertical bars of the *Genus Salmo*,—is all that I have obtained of its habits. Their flesh is deep yellow in some cases, in others white and of no great flavor. I am indebted to F. W. Putnam, Esq., Salem, for directing my attention to a description of this fish by Girard, in the proceedings of the Philadelphia Institute Natural Sciences, May, 1854, the only notice I believe extant, and thus preventing me noticing it as an undescribed species. I here beg to acknowledge his courtesy as well as the scientific knowledge so kindly given to an entire stranger. The following description is taken from specimens given me by Lt. Col. Hardy, the late Archdeacon Willis, and Canon Gilpin.

Length, about seventeen inches; breadth of widest part from first dorsal, two and a half inches; length of head, nearly two and a half inches; the shape of head fine and small, the back rising rather suddenly, from posterior to head, sloping very gradually upward to insertion of dorsal, thence downward to insertion of tail, lower line corresponding with line of back; a long elegant shaped fish with a strong base to a powerful tail; eye large nearly half an inch in diameter and two diameters from end of nose; opercles rounded, and with the pre-opercles marked with numerous concentric streaks; the lower line of inter-opercle parallel with line of the body, labials both upper and lower arched, line of pre-opercle not so rounded as opercle; the pectoral fins coming out very far forward almost touching the gill rays, dorsal commencing about two lengths of head from tip of nose, sub-quadrangular, free edge concave, ventral about opposite sixth ray of dorsal, adipose fin opposite posterior edge of anal, and caudal deeply cleft, and very nearly the length of head in depth. In one instance the tail was square, intermaxillaries, maxillaries, palatines, vomer and tongue armed with sharp and recurved teeth, the teeth on the vomer extending half an inch down the roof of mouth, a fleshy line extending from them to the gullet, the upper jaw notched to receive the lower. In two specimens a prolonged hook in lower jaw advancing beyond the teeth. Girard says the male fish has adipose fins opposite anterior edge of anal, the female opposite posterior edge. Whilst in the following description taken from a female fish I have verified his remarks, I have added, in the male the adipose fin is very much larger, which is almost the same thing. Colour black above shading down to sepia brown at the lateral line, the brown being the back ground to numerous black spots, some round, some lunated extending from opercles to tail. The opercles partake of the same general colour with yellow reflections and blue tints, but also marked with spots extending to the pre-opercles, beautifully round and distinct; sides yellowish and belly white with pearly tints, the whole covered with bright scales larger about the sides than beneath. The colours vary much by the reflected lights made by turning the fish. The colour of the fins fresh out of water, caudal brown, dorsal brownish black and spotted, lower fins dark brown, edges and tips dark, a very fleeting lavender wash on dorsal, sides yellowish. In one adult specimen I noticed a few red spots on sides, but in the young fish they are very marked and beautiful. Some seen by myself in July had vertical bars, red spots, were very silvery on sides and all even the smallest had the typical opercular spots very distinct.

They were exceedingly beautiful and might have readily been taken for a different species. On opening the fish, from gills to tail the heart with its single auricle and ventricle first presented, the liver overlapping the stomach and pale yellow, the stomach descended about one-half the length of the fish, was then reflected suddenly upon itself where it was covered by numerous *cœca* (about thirty), these are the *pyloric cœca* of authors. It then turned down again and soon was lost in small intestine ending at the vent. The spawn were each of the size of currants and bright scarlet, about a thousand in number, and encased in a very thin bilobular ovary, the left lobe occupying the left side, being a little over three inches, and only one-half the length of right lobe occupying right side; a second fish gave the same placing of ovary. Both these fish were taken on the 2nd and 4th November at Grand Lake, Halifax, and evidently near spawning. Fins, D. 12 or 13, P. 14, V. 9, A. 9, C. 20. Axillary scale small. The first dorsal ray in some instances contains two in others three small rays. Typical marks, spots on opercles.

The Loch Lomond trout near St. John, N. B. are identical with these fish; I saw some at Stubb's Hotel, taken by H. Gilbert, Esq.; Perley confounds them with *S. Ferox*. With the exception of Girard I believe this species has not been noticed by naturalists or sportsmen, yet it is worthy of notice from both, by one for its game qualities, and by the other for its most resembling the European trout, in its teeth down the vomer and brown colouring and spots.

Salmo Confinis—Dekay. *Salmo Adirondicus*—Norris.

For some years reports have been made of a large black fish seen in our interior lakes, principally from Chester. They were generally considered spent salmon. One gentleman about twenty years ago, built a boat, and camped for some time on the lakes, but was not successful. About two years ago Col. Sinclair sent two specimens to J. M. Jones, Esq., who identified them as the lesser lake trout, the *Salmo Confinis* of Dekay, common to most of the small lakes of the Northern States. Subsequently Col. Chearnley sent some to town taken by the Indians. From these and other specimens taken from great Pock Wock lake near Halifax, the following description is taken. The first, of one weighing about three pounds, and evidently a young fish.

Length eighteen and a half inches. Length of head one fourth of length to insertion of tail. In some others the head was rather longer. Insertion of first dorsal two lengths of head from tip of nose. The outline commencing from a round obtuse snout, rose almost immediately and suddenly, owing to the large orbit of a very large eye placed very high in the head, and ran gently upward to insertion of dorsal, then straight to adipose fin, then rather suddenly depressed to insertion of a very strong and deeply curved rather than forked tail. The outline of belly much more convex than that of back. The greatest

girth in front of dorsal and about one-quarter of length to insertion of tail. The labials arched, the eye very prominent and set high in the head, about two diameters from tip of nose, not quite four to outer edge of opercle, pre-opercle very thick and puffy, its outline at right angles with line of body, and subcircular. Interior edge of inter-opercle parallel with line of body. Colour fresh from water, black on back running to dusky below lateral line, where it assumes a yellowish wash and ending in white on the belly (one was mottled or obscurely spotted with white on sides, another had vertical bars of dusky). Head of the same colour as body, a little bronze on opercle and pre-opercle, tip and edges of chin blackish and below white. The dusky hue was caused by minute dots, the dots taking the form of scales on the belly. The colour of fins was—dorsal dusky yellow, spotted with three irregular rows of spots, rays lighter than webs, adipose blackish, pectoral and ventral yellowish dusky, when folded tips dark, a slight orange wash on tips, anal and caudal yellowish dusky, a slight orange wash on tips in anal. Teeth on palatines, vomer, upper and lower maxillaries, intermaxillaries and tongue, in one a few teeth down the centre of tongue as well as on the sides, upper lip notched to receive lower. D. 10, P. 14, V. 9, A. 8. Gill rays, 12. The first dorsal ray very thick, containing perhaps a rudimentary ray, the first rays of all the lower fins flat and thick, caudal cleft about one-half a length but outline rounded. Irides salmon yellow, scales minute, typical marks very large head, one-fourth length, fleshy pre-opercle and teeth down the middle of tongue.

These young fish resembled in outline, the plate of *S. Siscowitz* (Agassiz), the fins differing. They also resembled Norris's figure (*American Angler*) of *S. Adirondacus*, but in comparing them with other specimens weighing from seven to ten pounds, I found these last coincided with Dekay's figure, except that it is feebly drawn and not giving the strong characteristics of the adult fish, and that both, although the young fish was slender and elongated, and the older thick and stout, preserve the strong typical marks of the species. The large eyes set high in the head, and projecting orbit, the very fleshy pre-opercle, the short distance between posterior end of anal and caudal fins, the same colour and teeth, both having the very peculiar triple row on tongue, and the very large head. As the fish becomes larger all these typical marks become stronger, till one weighing twenty pounds or upwards, in his huge and fleshy jaws, thick back and tail and great girth, resembles more a cod than a salmon. Of the half dozen I examined, one, evidently an old fish, had an irregularity of caudal fins, the lower lobe much the longer. I attributed it to an injury, but Col. Hardy noticed the same irregularity, and Mr. T. Mackie, who has fished numbers of them, assured me it was quite common. I have no explanation for these facts. As regards colour, when taken immediately out of the water, the

heads are a dark greenish horn colour, the backs black, sides yellowish with spots and belly white. These colours are varied and heightened by the thick nacre and reflected lights of the scales. As the fish becomes stale, the nacre dries, and a light purplish or amethystine colour pervades the whole. The tip of caudal and lower fins faint orange or yellowish. *The third row of teeth* on the tongue so peculiar to this salmon alone, is not always to be found, even some adult fish have it not. Dekay and Perley give them, Frank Forrester not, yet each from actual inspection. I have examined specimens both with and without them. They are taken with a whole line, as fishermen call thirty fathoms. Our alpine lake basins having this great depth. The flesh is coarse. They are usually bottom feeders, though the Indians assert they will rise to a red rag, and perhaps never exceed twenty-two pounds, although there are many accounts of their huge size attained in lakes where there are no weighing scales.

In concluding, all what I could procure either personally or from reliable sources of this very interesting genus, a very few general remarks will suffice. In regard to teeth, we find as typical marks they are not so reliable as in the *Mammalia*. It is all but certain that *S. Salar* renews his teeth in the male twice a year. One species has a triple row on the tongue, and that not constant, the others having a double row. As regards vomerine teeth or rather teeth down the roof of the mouth, two, *Fontinalis* and *Canadensis* have none, or at best one tooth and that not constant, the *Salar* has two or three, and *Gloverii* and *Confinis* a strong row. I say teeth down the roof of mouth, for strictly speaking they all have vomerine teeth, for the palatine bones being each side of an arch of which the vomer is the keystone, and the palatine teeth being an uninterrupted circle round the arch, it follows that the head of the vomer always has teeth but not always down the bone. The author of that very pleasant book, "*Game Fish of the North*," should remember this when he asserts that *Fontinalis* has no vomerine teeth. When he indulges in sneers against naturalists, and smart writing about marine dentists, he should at least be correct, especially as only a scholar, a naturalist and sportsman combined, could have written as he has done of rock and flood. We have one species common to both worlds, another *Fontinalis*, in its teeth, red spots, rose belly, and

broad plated white edged orange fins, is the true analogue to the *Char* of Europe. Whilst *Gloverii*, in its brown colour and teeth resembles *Fario* of Europe and *Confinis*, the great lake trout of Scotland's lakes. So far I have never heard of *Corregonus* the analogue to the *Vendace* of England, but may find it at any time; not so with the splended analogue to the *Grayling* of Europe, the *Signifer* of Sir John Richardson. His range is too northern, and his great beauty and typical dorsal would have betrayed his whereabouts long since.

Art. XI. The Glacial Period in North America. By Thomas Belt, F. G. S.

[*Read May* 8, 1866.]

I.—INTRODUCTION.

Until the last few years most geologists have taught that the glacial period was one of a great submergence of northern land, over which floated icebergs bearing from more arctic regions, stones, gravel and clay. Agassiz had long ago argued that land and not floating ice had been the effective agent in the glaciation of countries, but his theory met with little support, until the investigations of Norwegian and Swedish geologists proved that the glaciation of the Scandinavian peninsula had radiated from the central mountains, and could not have been produced by currents drifting icebergs from the north. The same result has been worked out in Scotland by Mr. Jamieson, and in North Wales by Prof. Ramsay, and now geologists are agreed that at the time of the greatest developement of the ice in Europe, the land was elevated above its present level and covered with ice, which descending from the higher ranges, deepened and widened the valleys down which it flowed.

The continent of North America is more glaciated than that of

Europe, but there is not the same evidence of the radiation of the transported blocks from central heights; and whilst Agassiz, Dana and other eminent geologists have adopted the theory of land ice, Lyell and Dawson have advanced many arguments in favour of that of icebergs. The question is therefore an open one, and no where can it be more appropriately discussed than before this Institute; for Halifax stands on ice-moulded hills, on an ice-cut harbour, and is surrounded by glaciated rocks and ice-carried drift.

During the progress of the exploratory works of the Nova Scotia Gold Company, carried on under my direction, I obtained what appeared to me conclusive evidence, that neither during nor since the glacial period has the southern coast of Nova Scotia been covered by the waters of the ocean. I purpose in the present paper to describe these facts, prefacing them with a short sketch of the glaciated rocks and superficial deposits of the Atlantic coast of the Province, and afterwards to discuss the question of the glacial period in North America, of which these phenomena are the monuments.

II.—GLACIATED ROCKS AND DRIFT-BEDS OF NOVA SCOTIA.

1. *Eroded valleys and scratched rocks.*—The Atlantic coast of Nova Scotia is cut into by long, narrow deep bays or fiords. The direction of the bays is roughly north and south. The hard rocks that bound them exhibit everywhere glacial scratchings and groovings in an excellent state of preservation and with a similar north and south direction. Going farther from the coast the long bays give place to deep and often narrow lakes, also pointing north and south. Chains of lakes sometimes reaching across the country have the same direction.

The whole country is hugely cut into irregular meridional ridges and furrows, which are as much part of the glaciation of the land as the scratchings and groovings. The valleys are scooped out of extremely hard quartzites and other metamorphosed rocks. These are highly inclined, and their strike is north-east and south-west. The valleys have been excavated across their upturned edges, transversely to their strike. Scratches and grooves might be caused by icebergs grinding along the bottom of a shallow sea, but the glaciation of a continent and especially the scooping out of long valleys, requires the uniform action of a more powerful agency.

2. *Drift-beds.*—It is, however, in the composition and distribution of the drift-beds that we find the most convincing evidence of the supra-marine character of the glaciating agent. In Nova Scotia the hollows are comparatively free from drift excepting where mounds across valleys mark the position of old terminal moraines. It has generally been pushed into recesses in the ranges, or to the south end of hills where it was sheltered from the ice moving southward.

Thus Lake Thomas near Waverly is bounded to the west by a rather steep range running north and south parallel to the lake, down to and into which it rapidly slopes. The structure of this hill has been well exposed by cuttings made in search of auriferous quartz veins. The northern end and the side next the lake has a thin covering of clay, gravel and boulders. The bed-rock is rounded, scored and grooved. Masses of quartz have been broken off from the lode and carried southwards. The southern end of the hill is composed entirely of clay, gravel and large angular stones. A tunnel was driven into it for about two hundred feet and no solid rock could be found, nothing but huge stones and other drift pushed in under the lee of the rocky beds to the north.

The transported blocks and the direction of the scratchings show that the glaciating agent moved from the north. If it had been floating ice and the hill at the time a submerged rock, the icebergs ought to have stranded on and deposited their freight at the northern, and not at the southern end. If on the contrary it was glacier ice the phenomena are just such as we might expect to find.

Again, if this drift had been dropped from icebergs floating over a submerged land, and we could imagine any possible means by which it could be arranged as we find it, we have still to account for the greater difficulty, that whilst the land slowly rose again from beneath the waters of the supposed glacial sea, and was exposed to the action of the waves on the spreading coast line, these ridges of incoherent drift were left unlevelled, and these bare hollows were left unfilled.

3. *Gold in the Drift.* — Through much of the drift grain gold is sparingly disseminated, and its distribution affords another argument in favour of the supra-marine theory. In Australia all the most important deposits of alluvial gold have been found in valleys lying immediately above the bed rock, beneath beds of gravel and clay ; wherever surface washings have been discovered much richer

deep sinkings have been found in the vicinity. This indeed seems to be a necessary result of the sorting arrangement of water.

But in Nova Scotia, though denuded auriferous quartz lodes are abundant, no similar deposits have been found with one exception, to the consideration of which I will return. The gold instead of being concentrated at the bottom of the superficial deposits, is either distributed throughout them, or occurs in greater abundance at the surface than below.

At Lawrencetown extensive washings were projected, in consequence of the discovery of spangles and grains of gold in the surface soil. It was expected that it would be found in larger quantities in the lower parts of the beds of gravel, as in other gold producing countries; but these expectations were not realized. A little gold was found throughout the gravel, but nowhere so abundantly as at the surface. Probably the gold had been originally distributed throughout the drift, and its partial concentration at the surface had been caused by subærial denudation. The process of denudation may be seen in operation on every hill side. During the severe winter the ground freezes to about two feet from the surface; when the spring thaws set in this is completely disintegrated, and much of the finer soil is carried off into the rivers by the water from the melting ice and falling rains. The heavier stones and the gold are left behind, and thus are produced the surface gold washings, and the surface accumulations of stones culminating in the well known barrens of the Province. Since these gravels were deposited, they cannot have been rearranged by water; its sorting action would have carried the heavier gold to the bottom of the deposits, as in other gold producing countries.

The great richness of the gold washings in Australia and their scarcity and poverty in Nova Scotia, notwithstanding the abundance of auriferous lodes that have been denuded, may be thus explained: In Australia the denuding agent was water, which carried off the ground up rocks but left behind the gold—so that in the gravel beds nearly all the gold but only a small proportion of the original rock mass is left. In Nova Scotia the denuding agent was glacier ice, which carried off alike the stony masses and their metallic contents. The drift-beds left contain only the same proportion of gold as ex-

isted in the original rock mass, excepting where subærial denudation has concentrated it on the surface.

Perhaps in sediments older than the glacial period and which have escaped destruction during it, or in the beds of existing streams, or on the present sea coast, deposits of grain gold may be found, but they will be only the exceptions to the general rule. I have mentioned one exception. It belongs to the third class: it has been produced by the waves of the sea on the existing coast line. I refer to the gold washings at the Ovens, near Lunenburgh, which, though limited in extent and soon exhausted, for a time largely remunerated some of those employed upon them. From the side of a rocky promontory, traversed by numerous small auriferous quartz veins, spreads out a bed of glacial drift, throughout which grain gold is sparingly disseminated. The sea is slowly eating into this bed and rearranging its materials. It grinds up the stones to shingle and finally to sand and mud, which it carries off to deeper water, leaving behind the tough heavy gold. This is found at the bottom of the shingle between tide marks, on the surface and in the crevices of the bed rock, where the gold formerly distributed throughout a large mass of drift has been concentrated. Now if the country had been submerged during the deposition of the glacial drift, every part of it, during its subsequent elevation, would at some time have formed a portion of its ever advancing coast line, and been subjected to the action of the waves; and such deposits as those of Lunenburgh instead of being confined to the present shore would have been formed all over the emerging land.

4. *Marine Beds of the St. Lawrence.*—In the valley of the St. Lawrence marine beds with sea shells are found at various elevations, up to five hundred feet above the sea near Montreal. These beds lie above the glacial drifts, and prove that subsequently to the deposition of the latter, the country was submerged to at least the height at which the marine beds are found. From a consideration of the facts stated above, I am convinced that the Atlantic coast of Nova Scotia did not participate in this depression, and a study of the marine deposits themselves leads to the same conclusion. At Montreal sea shells have been found up to a height of five hundred feet above the sea, but lower down the St. Lawrence they do not occur excepting at a lower level. Thus on the Metis river they are found at a height

of two hundred and forty-five feet, and lower down still at Matan river they have not been found much higher than fifty feet above the sea. I do not suppose that these shells mark the extreme heights to which the sea has reached at the different places, but so far as the observations go, they show a decrease of the submergence towards the mouth of the Gulf. I am not acquainted with the drift-beds of the Province of New Brunswick, but I have no doubt that they will be found to bear out the same inference, namely, that going eastward from Montreal the elevation of the marine beds marking the former submergence of the land gradually decreases, until in Nova Scotia it reaches zero.

The gold washings of the valley of the Chaudiere within the area that we know, which from the evidence of sea shells was submerged after the glacial period, show us what would have been found in the auriferous districts of Nova Scotia, if that Province had also been submerged. The absence of gold washings in Nova Scotia and their presence in Lower Canada, are strictly in unison with the absence of marine deposits with sea shells in the one district and their presence in the other.

II.—ORIGIN OF THE GLACIAL PERIOD.

1. *Theories of origin.*—It is far beyond the scope of this paper to enter upon the discussion, or even to give an account of the various theories that have been advanced in explanation of the origin of the glacial period. It is less necessary for me to do so as the whole question is quite a modern one, and the views of Croll, Frankland and others have been so recently made public, that the scientific world is well acquainted with them and with the objections that have been urged against them. I will therefore confine myself to the consideration of the one that seems to me the most satisfactory

Sir Chas. Lyell in his admirable *Principles of Geology* long ago showed that the extremes of heat and cold might be produced by the grouping of the land; in the one case, about the equator, and in the other, about the poles. There can be no doubt that a rise of polar and a submergence of tropical and sub-tropical lands, would greatly lower the temperature of the arctic and temperate zones.

That during the glacial period or part of it, the land now glaciated stood somewhat higher than at present, has been inferred from

the depths to which fiords have been excavated, and from the fact of littoral shells having been dredged many miles from existing coasts. With regard to the submergence of tropical and sub-tropical lands, it is now well established that at the same period the African Sahara was covered by the waters of the ocean, so that we have an approach towards the conditions required for the production of extreme cold. That the conditions were all fulfilled is very improbable, indeed that they were not is proved by the ice having extended much farther south in North America than in Europe.

2. *Recent changes of level of the land in northern hemisphere greatest towards the pole.*—In a paper on some movements of the earth's surface in recent times,* I have remarked that in two instances in the northern hemisphere, one of depression, the other of elevation, the movement is greatest towards the pole. This matter is so important in dealing with the question of the probability of a rise of Arctic lands in the glacial epoch that I may be permitted to refer to it again, and to supplement the argument with some additional facts bearing upon it.

It has long been known that parts of the coasts of Sweden and Norway were slowly rising, and in the time of Linnæus marks were made on the rocks by which the rate of elevation at different points has been determined. It appears that at Gottenberg in the south, the land is only being raised about four inches in a century, but that the rate of motion gradually increases northwards, until at Cape Cod, the extreme point where it has been measured, the land is being raised about four feet in a century.

Opposite to this area of elevation, on the other side of the Atlantic, there is a corresponding area of depression. It appears to be well established that the Atlantic sea board of North America is slowly sinking. In New England the subsidence is scarcely perceptible, but it gradually increases as we proceed northwards. In Nova Scotia the submergence of marsh lands and of rocks has been generally remarked by the residents on the coast, and Cobequid bay and Cumberland basin submarine forests attest the long continuance of the downward motion. This subsidence attains its maximum on the west coast of Greenland, where the land is so rapidly sinking that in quite recent times the settlers have had to move

*These Transactions, vol. I, Part I, p. 24.

inland more than once the poles on which their large boats are placed. Here again the rate of motion is greatest towards the pole.

The present period of subsidence was preceded in part of eastern North America by one of elevation, which brought up the marine deposits of the Champlain period; to which the Montreal beds already mentioned belong. On the southern borders of New England these marine beds are only found up to about forty feet above the sea. As we proceed north they are found higher and higher. At Montreal they reach to five hundred feet above the sea, and in the extreme north, on Cornwallis and Beechey Islands in Barrow Straits, they have been found at an elevation of over one thousand feet. Here again the elevation is greatest towards the pole and gradually decreases southwards. To produce extreme cold according to Sir Chas. Lyell's theory, we only require a similar movement on a larger scale, and these smaller oscillations with their vertices towards the pole, may point to some general law governing the upheaval and subsidence of the earth's crust which would, if it could be deduced, explain the elevation of the land towards the north and its depression towards the south during the glacial period.

3. *Effect of shutting off warm currents from the Polar Basin.*—We do not know how small a change in the distribution of land and water might again produce a glacial climate. The effect of a change in the direction of the Gulf Stream, has been discussed by Mr. Hopkins and other writers, but I do not think that it has been noticed that a much greater change of climate would be produced, if all warm currents were shut off from the polar basin. Sir John Herschel has indeed stated that if Behring's Straits, which are only thirty miles broad, were closed so as to prevent the water circulating from a warmer region, finding its way into the polar basin, there would probably be a continual accretion of ice which might rise to a mountainous height.*

But if, besides the closing of Behring's Straits, there were a partial emergence of land from beneath the ocean, connecting Europe through Iceland and Newfoundland with America, we can scarcely appreciate the effect it would have in altering the climate of the northern hemisphere. There would not only be a great lowering of temperature through the increase of land around the poles, but

*Herschel's Physical Geography, page 41.

the heat of the Gulf Stream and other warm currents that is now expended in tempering Arctic seasons and melting polar ice, would then be spent in evaporation; and greater evaporation would give greater precipitation on the frozen lands of the north. The formation of continental ice requires both a low mean temperature and an abundance of moisture. The rise of northern lands, and the closing of the Arctic basin to southern waters, would give the one, and the greater warmth of tropical and sub-tropical seas, into which no polar currents ran and from which no warm waters flowed, would give the other.

IV.—ACTION OF THE ICE.

1. *Statement of the question.*—Turning our attention now to the possibility of land ice having glaciated the whole of eastern North America, we encounter the difficulty that has prevented many from accepting the theory of continental ice, who are fully impressed with the satisfactory solution it affords of the distribution of the drift-beds and the erosion of valleys. It is that whilst the rock scratchings and transported blocks prove that the glaciating agent moved from the north, there are no mountains in that direction from which it could have descended, and that any elevation of Arctic regions sufficient to give a slope that would bring the ice southwards like a great glacier is utterly improbable, if not physically impossible. With this opinion I fully coincide, but so far from considering it fatal to the theory of land ice, I believe that no such slope was necessary, and that the theory better explains the phenomena of the drift, on the supposition that there was no great elevation of northern lands than by a contrary hypothesis.

The subject may be best understood by tracing in imagination the accumulation of the ice and its progress southwards, its culmination and subsequent retreat, and noting whether or not its probable mode of action will account for the facts to be explained. It will be convenient to limit the discussion to one great area such as that of eastern North America, where the glaciation though on a grander scale than elsewhere, is more uniform from the very vastness of the agent that effected it.

2. *Accumulation of the ice.*—As the glacial period, from whatever cause, came on, snow and ice would gradually spread from the arctic circle southwards. Wherever there was not inclination of the

surface sufficient to carry it off bodily, as a glacier it would accumulate and be piled up until the higher portions slipped over the lower.

It has been suggested above that one of the most powerful causes that brought on the glacial period, was the shutting off the gulf stream and other warm currents from the arctic area, where at the present time they are ceaselessly employed in ameliorating the climate and melting up the ice at its source. They now eat into the very vitals of the icy foe, which attacked and routed in the rear draws in its forces to its inmost citadel. In the glacial period the breaches that now let in the invading waters from the south, were closed, and the icy hosts gathering in the north, pushed out their legions southwards, and drew their very sustenance from the forces that now beat them back to their arctic fortress.

Piled up then in the north the ice and snow would spread southwards. Where it encountered a high range running transversely to its flow, it would at first be diverted from its course, but it would gradually accumulate behind the obstacle until it overtopped it, at first flowing through passes in the range and ultimately overwhelming the whole ridge. In advance of the great mass, streams of ice would flow down pre-existing valleys and through passes in opposing ranges, deepening, widening and glaciating them, like pioneers cutting out roads for the main body. In some cases, passes through chains of hills would determine the erosion of valleys in front of them, by the ice that poured through from behind.

This moving margin of the advancing ice would be the effective tool in glaciating the country. To its action every portion of the surface would be exposed, whether its slope conformed to the course of the ice flow or was opposed to it; just as every part of a coast between tide marks is washed by the rising flood. And as the waves run forward on the shore and retire, to again advance, and again retreat, although the whole body of water is steadily rising, so we may suppose that the ice margin might greatly advance during a series of cold seasons, and retreat during warmer ones, to be again thrust forward and again drawn back, although during a great number of years the advance of the main body of ice would carry the fluctuating margin far forward and subject a new zone to its action. Thus the whole continent from the arctic circle to as far south as

Baltimore and Ohio was slowly and successively worked over. Many of its old valleys would be deepened and many new ones excavated. Lines of faults, of fractured or of softer strata, would be worn into valleys and lake basins. Everywhere the ice would find out the weakest points of the rock masses and work deepest there.

The moving margin of the ice flow and especially the glaciers thrown out in advance, would be the great producers and carriers of drift. The stones borne along upon a glacier are from the cliffs and peaks that rise above it and not from the rocks beneath, over which it passes. The latter are only smoothed and rounded, but the cliffs that bound a glacier are eaten into like a river bank. Masses of rock are undermined and fall down upon and are carried away on the ice, to be deposited in terminal and lateral moraines.

3. *Culmination.*—At last the ice reaches its limits. Mount Washington is glaciated nearly to its summit, and at the time when there was most ice only its top could have stood out—a desolate island in a frozen sea. To the north the whole continent must have been covered without a single peak rising above the universal pall.

It is probable that during the greatest development of the ice, most of the drift that had been produced would be destroyed by being ground to powder under the mighty moving mass, and carried away in the water which we know flows turbid from beneath every glacier. The time of thickest ice was not that of the production of drift, but of the rounding, polishing and grooving of mountain masses. Could the icy covering have been lifted the rocky skeleton of the country would have been exposed, with scarcely a patch of gravel or soil upon its bare, scarred frame.

The scratchings on the highest peaks show that the main body of the ice moved south-easterly. Here we see the action of two forces—one, from the north, was the accumulation of ice in that direction; the other, from the west, was the slope of the continent towards its eastern sea board.

4. *Retreat.*—If then drift was not formed when the ice was at its height, and that which had been produced during its advance was then destroyed; whence the heaps of gravel and the transported blocks that now cover the face of the country? They were distributed during the slow retreat of the ice, when again every part of the country was subjected to the action of the moving margin. Just

as the whole of a sandy beach is rippled between high and low water marks by the retiring tide, so during the gradual retrogression of the continental ice, every portion of the country that had been covered, —from the valleys of the Ohio and the Missouri to the Arctic hills, and from the summits of the hills to the bottoms of the deepest valleys,—became again for a time, as they had been during the advance of the ice, the shore of an ice sea, or the boundary of an ice stream. Again the ice wore into its rising banks and carried off stones and gravel and formed terminal and lateral moraines.

The transportation of drift from any region began as soon as any of its mountain tops emerged above the subsiding ice. The highest peaks would send the farthest carried fragments, and lower and lower as the ice flow ebbed, so nearer and nearer to their source would its burdens be deposited.

Like its advance, the retreat of the ice was probably slow and fluctuating. During some seasons it would diminish greatly; during others advance again, but taking a number of years together there would be a decided retreat. The ice would act on the rocks during its subsidence as it had done during its rise, but the drift formed and deposited instead of being destroyed by the advancing mass, was left in the valleys and on the hills as we now find it. The only differences on the southern coast of Nova Scotia that we can detect are, that the moraines in the valleys have often been cut through either by the streams that issued from beneath the retiring glaciers, or by those that now run through them, and that large stones and grain gold have been concentrated on the surfaces of drift-beds on the hill sides.

V.—APPLICATION OF THE THEORY TO SOME OF THE PHENOMENA OF THE DRIFT.

1. *Local character of the drift.*—Having thus sketched out the probable action of the ice during its advance, culmination and retreat, and explained the general distribution of the drift, it only remains to apply the theory to a few of its more striking features. The local character of most of the drift stones in Nova Scotia is one of these. Here and there a few blocks of granite are found, that have been brought two, four, or even eight miles, but the great majority of fragments belong to the rock formation over which they lie. Boulders of slate occur where bands of slate cross the country,

and boulders of quartzite where the bed rock is quartzite. Fragments of quartz sometimes containing gold are easily traced to the lodes (invariably to the north of them) from which they have been detached, and thus many auriferous lodes have been discovered.

The local character of the stones in the drift is opposed to the supposition that to the north the land was so elevated that the ice moved over the country like a great glacier, and is in favor of the theory that it was formed by the retreating margin of a great accumulation of ice. If there had been during the glacial period, high mountains to the north of Nova Scotia, far travelled blocks would have been of frequent occurrence. But without high ranges northwards and with its own hills only of moderate elevation, we find as we might expect, that the blocks are easily traced to their parent rock. Some boulders of granite have been carried farther, because here and there granite hills rise above the general elevation of the country.

2. *Transported blocks of Berkshire, Massachusetts.*—Sir Chas. Lyell has described some long trains of large blocks that in Berkshire, Massachusetts run, in nearly straight line, for distances of five, ten and twenty miles, across hill and dale alike.* The direction of the trains is N. W. and S. E., and they cross three chains of hills with intervening valleys running N. N. E., and S. S. W. The blocks, starting from the most north-westerly ridge, pass in long lines across the valley to the next, and on to and in like manner through gaps in the third range.

It is argued that these blocks could not have been carried by glaciers, as they would have followed the slope of the valleys and not have crossed them; and that it is more likely that they were dropped by icebergs when the country was submerged, so that the tops of the hills became islands and the passes straits, through which the icebergs floated driven by a current from the north-west. The argument is a valid one against a theory of local glaciers, but not against that of continental ice. I have already shown how the advancing ice would act when it encountered ranges running transversely to its flow. This is an example, only I suppose the blocks were left by the retiring ice when the same process was repeated. At its greatest height the ice covered the ranges and rounded them. When during its subsi-

*Lyell's Antiquity of Man, page 356.

dence the highest points rose above the ice, rocks would be undermined and carried away. As the ice diminished and the ranges emerged, a time would arrive when the passes would become icy straits through which flowed ice from behind. It could not move down the valleys, for at that time the great north and south valleys of the Hudson and the Connecticut must have been filled with the ice that dammed up the lateral valleys.

The first stage in the formation of the trains began when the two valleys were filled with ice, and glaciers streamed through the passes in the most southern range bearing blocks from those behind. As the glaciers wasted the boulders would be left in lines marking the retrogressive points to which they reached. When the passes of the third range were free from ice it would still flow through those of the second, and as it receded it would leave step by step the monuments that now mark the direction it took. The resemblance of many of the phenomena of the drift to those that might have been produced by floating ice, proceeds from this,—that the valleys were filled with ice as they would have been by water in the former case, and that glaciers flowing through the gorges in the hills took the place of the suppositious icebergs.

3. *Drift of the St. Lawrence.*—Dr. Dawson of Montreal, has pointed out that the drift of the valley of the St. Lawrence has been carried up the valley. He argues that it ought to have been carried down it if the transporting agent had been land and not floating ice.

This objection is again rather against a theory of local glaciers conforming to the slope of the valleys, than that of continental ice.

The great valley runs from south west to north east, and the ice coming from the north must have flowed up it, if it was influenced by it at all. The general direction of the ice flow was from N. N. W. to S. S. E., but it could scarcely fail to be somewhat influenced by such a wide and deep valley running obliquely to its course. The valley must have filled from the bottom upwards, and drift would be carried from the high grounds on the sides to the bottom of the valley farther up, even if the ice was not pushed up by the weight of the mass behind. Again, when the ice from the north reached the bottom of the valley of the St. Lawrence, it would dam it up, and a great inland fresh water sea might be formed, up which would float

icebergs. Thus all the phenomena might be produced that characterise a submerged country, excepting remains of marine life.

The accumulation of ice in the region of Lake Champlain, caused by the valley of the St. Lawrence diverting in that direction that which would otherwise have flowed to the south-east, might furnish the advocates of the excavation of lake basins by ice, with an argument in favour of their theory.

4. *Terraces and stratified deposits.*—In Nova Scotia, terraces and stratified beds of sand and gravel are not uncommon. I have noticed a very conspicuous terrace running at the same height on both sides of a valley running into Cole Harbour, and which is crossed by the Lawrence-town road. Stratified beds of sand are found in many of the valleys tributary to the Shubenacadie lakes. These undoubtedly point to the action of water, but the entire absence of marine remains might make us pause before we came to the conclusion that they were formed by the sea. All the examples that have come under my notice occurred in lateral valleys, such as for instance those running into Cole Harbour, and into the Shubenacadie lakes. I believe that they were formed on the shores of lakes, caused by the damming up of the lateral valleys by the great glaciers that flowed down the principal ones.

VI.—CONCLUSION.

The question that I have discussed in this paper is so extensive that it would require a volume to discuss it fully and in detail.

This I have not attempted to do, as not only was it far beyond the limits of this paper, but already the glacial period both in Europe and America, has received great attention from eminent geologists, and its leading facts are well known. I have therefore confined myself to original observations made in Nova Scotia, and to deductions therefrom; and in the discussion of the general question have only given prominence to what I believe to be new or modified views respecting the origin of the ice of the glacial period and its mode of action. I will briefly recapitulate the conclusions arrived at.

1. The arrangement of the heaps of gravel on the flanks of hills, and the distribution in them of grain gold, in Nova Scotia, are opposed to the theory of the submergence of the country either during or since the glacial period.

2. The submergence of part of eastern North America, during which the marine beds of the Champlain period were formed, was not participated in by the southern coast of Nova Scotia.
3. To explain the movement of land ice from the Arctic regions southwards, it is not necessary to suppose that the continent to the north must have been greatly elevated, nor do the facts connected with the distribution of the drift agree with such a supposition.
4. That there was some elevation of northern lands during the glacial period is, however, probable: *Firstly*, because all the oscillations of level of the lands in the northern hemisphere since the glacial period, with which we are acquainted, have been greatest towards the pole; and *secondly*, because a rise of land sufficient to prevent the entrance of heated currents to the polar basin, would occasion a great accumulation of ice in the circumpolar regions, by the heat of the tropical and sub-tropical waters being spent in evaporation instead of, as at present, in melting the ice within the Arctic circle.
5. The drift-beds were formed during the retreat of the ice, and not during its greatest development.
6. Terraces and stratified beds in lateral valleys, were formed when these were filled with water, dammed back by the glaciers that still flowed down the main valleys.

Art. XII.—Geology of Antigonish County, N. S. By Rev. D. Honeyman, D. C. L., F. G. S., Member of the Geol. Soc. of France, Hon. Memb. of Geol. Assoc. London, &c.

[*Read May* 8, 1866.]

This county, known until lately as the county of Sydney, is the north-east county of Nova Scotia proper. It is bounded on the north by Northumberland strait, which separates it from Prince Edward Island,—on the east by St. George's Bay,—on the south by the county of Guysboro',—and on the west by the county of Pictou. It is somewhat mountainous, and contains numerous small lakes and streams. The principal mountains are the Antigonish mountains, whose corner nearest to the town of Antigonish is about three miles to the north-west. Considering this range as sub-triangular, one

side stretches in a westerly direction into the county of Pictou, its length being about thirteen miles, terminating in the Marshy Hope, and in its progress forming one of the lofty walls of this beautiful valley; the eastern side stretches northerly, terminating near Malignant cove, and extending about eight miles; the remaining side begins with the sub-conical mountain which terminates the side just described, and extending in a general south-west direction until it unites the Pictou termination of the first side. The Arisaig mountains, of my Geology of Arisaig, form the Antigonish part of this side of the triangle. Another range commences about two miles south-east of Malignant cove, and runs parallel to the shore of Northumberland Strait, until it reaches about two miles from the north side of Cape St. George. The Sugar Loaf mountain, which rises a mile and a half from the town, begins another range, which extends in a northerly direction to Morristown, a distance of about seven miles. The last range is the Ohio mountains, which this county has in common with Pictou county. These nearly meet the Antigonish mountains at the Marshy Hope, and form its other wall. The eastern side of this range, beginning at the Beaver Meadow about two miles from the entrance of the Marshy Hope and about eight miles west of Antigonish, trends in a southerly direction about nine miles, sending off a spur towards Lochabar lake. This lake is about twelve miles south-west of the town; it is five miles in length, reaching a little beyond the county line into Guysboro' county. About three or four miles east of this lake we have Polson's lake and South River lake. Besides these there are Gaspereaux lake, about four miles south-west of Antigonish, and the North and South lakes of Morristown. The streams are the South River, which rises in South River lake, is fed by Polson's lake, winds through fertile intervales receiving numerous small streams, and at length flows into Antigonish harbour. Ohio River rises in the Ohio mountains, flows through beautiful and fertile meadows, and unites with James' River, which rises in the Antigonish mountains, in West River. This last after flowing and winding through fertile meadows, receives at the town the tributaries of Rights River and Braley Brook, which also rise in the Antigonish mountains, and then it flows into the harbour. Besides these there is North River, which flows into the north side

of the harbour. In the north of the county there are Malignant brook, Doctor's brook, Arisaig brook and McAra's brook.

As a field for the practical geologist this county is of the highest importance. Here we have all the geological formations that are known to exist between the old silurian of our gold fields and our Bay of Fundy triassic, and situated in a line connecting distinguished representatives of both. We appear to have in this county the lineal and direct descendants of the formation, which extending through Guysboro' on the south, has the gold fields of Sherbrooke, Wine harbour and Isaac's harbour—as we have the direct predecessors of Prince Edward Island triassic on the north. The greater number of the formations in the county are represented in Arisaig on Northumberland Strait. In my paper on the Geology of Arisaig I have already explained the character of the group, designating the lowest member of the series A, and the others in ascending order B, B', C, D. By comparing a large collection of the fossils of D with the figures of the Upper Ludlow fauna in Nicholson's Siluria, I was convinced that D was equivalent to the Upper Ludlow. Dr. Dawson simultaneously designated it Lower Helderberg, of which the other is the British equivalent. This was the first step in the proper designation of the Arisaig series, this opinion being subsequently confirmed by Mr. Salter on an examination of my specimens in the exhibition of 1862. Dr. Dawson and Prof. Hall had given it as their opinion, that B' was equal to the Clinton, as a characteristic of this is a graptolithus not distinguishable from the *G. Clintenensis* (Hall). Mr. Salter regarding the specimens in the exhibition as *G. Ludensis* considered B as Ludlow, while he considered the specimens from C as equivalent to the Aymestry limestone. The fossils of B were not discovered until I made the minute examination of the district of which my Arisaig paper is the record. The bed of graptolites found in B led me to regard it as of age prior to the Upper Ludlow. Shut up by Mr. Salter's opinion on A, which he was led to consider from the few specimens then collected as equivalent to the May Hill sandstone, I was induced to regard B as the equivalent of the Lower Ludlow. I had thus come to the conclusion, that the Arisaig group was wholly Upper Silurian.

Hall's noble work on the Canadian Graptolites, has led me to consider that there is yet something to be done in the correct deter-

amination 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 and 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, so that in Arisaig

A and B are probably equivalent to the Hudson River Group —Lower Silurian

B = the Clinton,
C = the Niagara Limestone, } Upper Silurian.
D = the Lower Helderberg,

It may be interesting to observe that graptolite life in Nova Scotia appears to range higher than in the United States, as according to Hall and Dana, *Graptolithus Clintonensis* existed alone there, and was the last of its race, while with us *Graptolithus Clintonensis* is associated with several other monoprionideans, and in 1864 I found in C, associated with crinoids, in shale interbedded among strata containing noble *cephalopoda, a diprionidean* graptolite of singular size and form. This graptolite is being examined by Prof. Wyville Thomson, and is to be described and figured in his work on Graptolites. Since I wrote the paper on the Geology of Arisaig referred to, I have had occasion to make a more particular examination than I had before made of the junction of the silurian with the carboniferous, at McAra's brook, and I am led to believe, by comparison with other localities, especially with Lochaber, which we shall shortly examine, that the apparent uncomformability is not real, and that the strata exposed on the shore and up the brook, are a formation intermediate between D, the equivalent of the upper Ludlow or lower Helderberg, and the lower carboniferous that forms the adjacent mountain west of the brook, in other words that the strata in question are Devonian. From these observations it would appear that in Arisaig we have a series ascending from the Hudson River age into the lower carboniferous, without any break in succession. These observations tend to modify the opinion expressed by Prof. Leslie, quoted by Dr. Bigsby in his paper read before the Geological Society—"On Missing Sedimentary Formations." It appears from this that Prof. Leslie is of opinion that the lower carboniferous at Arisaig lies unconformably on the Clinton equivalent. At Lochaber lake, which was mentioned in an introduc-

tion as in the extreme south of the county, while Arisaig is on its northern boundary, we have a group of strata of Arisaig age. My attention was first directed to this locality by finding a beautiful cast of a *Petraia Forresteri—Salter*. Subsequent examination of the rocks on the west side of the lake disclosed a set of strata with organisms of a peculiar kind and different from any of our former acquaintance. I found the *Petraia* in abundance and evidently characteristic, associated with casts of strange *orthes* and *rhynconellæ*, and a trumpet shaped cornulite. The containing strata rest on the syenitic rocks of the spur of the Ohio mountain already referred to. Similar *Petraia* led to the discovery and identification of the same formation at Arisaig, Marshy Hope, James river, and at Barney's river, French river and East river in the county of Pictou, all occupying the same position in relation to the syenitic, except at Arisaig, where the strata in question are synclinal. These strata, which I designated in the Arisaig group, A, are at Lochaber associated with other strata, which appear lithologically identical, but are distinguishable into Arisaig A, C, D, by the fossils which we find in the loose rocks. In these we find the *Homalonatus* of C, the *Dalmania Logani*, *Crania Acadiensis* of D, and *in situ* at the side of the lake I have found Nova Scotia *Chonetes* of D. Succeeding the strata containing the *Chonetes* and occupying the same relative position as the strata which I consider as Devonian at Arisaig, is a very broad band of reddish brown and grey argillaceous slates, which form an island in the lake extending 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; and at right angles to the strike they pass into Guysboro'. On the western side of Lochaber lake there are magnificent exposures of the brownish red strata, in the course of a small brook that enters the lake. To the south of the brook there is a thick band of laminated limestone, altered and contorted, containing blue fluor spar. Between Lochaber lake and Polson's lake these slates contain veins of quartz of considerable thickness, interspersed with 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 contain crystals of colourless quartz of considerable size and beauty. We also find garnets at Polson's lake and rhombic duodecahedral

crystals of iron pyrites to the west of Lochaber lake, but these are not found *in situ*. The upper part of this band of Devonian slates at Polson's lake, is of a darker hue than the others. In these are found a vein of specular iron ore of considerable thickness, highly micaceous, and among the drift are masses of oxide of iron with cupriferous iron pyrites. Attached slate show decisively that these have been derived from the underlying slate, and it is probable that the massive oxide of iron was originally a carbonate of iron. Small veins of carbonate of iron with copper pyrites have been found in the slates exposed by mining. I would observe that these strata in this locality have been complicated by trap dykes, and considerably eroded and obscured. I have been unable to discover fossils in this extensive formation. In the Marshy Hope which is intermediate between Arisaig and Lochaber, there are certain hard slaty rocks outcropping about ten and eleven miles from the town, where the Antigonish mountains come near to the highway. After the discovery of the *Petraia* (A) rocks of Lochaber, I observed those of Marshy Hope, and was struck with the resemblance between the two, and on examination I found that they were identical. In the latter locality I discovered *Lingulæ*, then *Petraia Forresteri*, *Orthoceres*, *Orthes*, *Cornulites*, and *Cornulites* (trumpet-shaped), &c. Subsequently I found, although not *in situ*, still nearer to the town, near the Antigonish mountain road and near a small tributary of James' river, other fossils of the same age. These discoveries led to the conclusion that the one is the extension of the other, and that they do exist or have existed as a band skirting the Antigonish mountains. This opinion was confirmed by a still farther discovery of similar rocks containing similar organisms at the western extremity of these mountains, on the side of the road at the western entrance of the Marshy Hope. I have not yet succeeded in ascertaining their eastern termination. In the place where I first discovered the strata in question in the Marshy Hope, I also found a specimen of the *Avicula Honeymani* (Hall). This fossil is one of the characteristics of Arisaig D. It is found in abundance in this position, both at Arisaig and East River, Pictou, and in this position only. I am persuaded that we have here Arisaig A and D, or the equivalents of the Hudson (?) and lower Helderberg in contact, while B, B' and C are missing. We have several out-crops of rocks from this

onward to the town of Antigonish for a distance of about five miles, —which furnish a section of the sedimentary rocks of this side of these mountains. In the first mile the order is descending, as in the next outcrop we have only A. About a mile nearer the town we have a large outcrop of quartzite, which I regard as Devonian. One mile nearer we have outcrops of lower carboniferous conglomerate, succeeded by limestone, and then six miles from Antigonish we pass between gypsum pits. The Devonian quartzite which is of greenish hue, appears to be of considerable thickness. It is exposed in various places on the flanks of the Antigonish mountains. There is a grand exposure at the falls of James' river. These rocks form an elevated peak which rises abruptly above the falls. The water flows in great volume over precipitous rocks, and from a height of about one hundred feet into a capacious basin, the whole presenting a scene of impressive grandeur. These strata appear also to constitute, to a great extent, "the mountain," at the south-east angle of the range, and after a break of about two miles they appear outcropping near the top of the Sugar Loaf mountain.

I have thus directed attention to the earlier sedimentary formations existing in this county—the Silurian and Devonian. It will have been observed that there has been considerable irregularity in the deposition of the strata that have passed under review. Comparing as I have done, the respective localities with the Arisaig type, we find that B and B' are missing at Lochabar, and that B, B' and C are missing at the Marshy Hope, while in both of these localities there is a greater development of the Devonian than we find at Arisaig, so that it is impossible to lay down any trustworthy rule in regard to the occurrence of any member of the series, where we have no outcrop or other superficial indications; in other words we may have Silurian, and no Devonian underlying more recent formations, and *vice versa*. As to origin, the strata are marine—A, the lowest of the series having been deposited in comparatively shallow water, possibly about seventy fathoms, while B, B' manifest deposition at a greater depth, and the aggregate thickness of the Silurian and Devonian would appear to require still greater depth of water for their deposition. This shows that in the process of their formation there was subsidence as well as deposition. Their present superficial position, their great elevation, especially at Lochaber, above the sea

level, and the vertical position into which they have been thrown, show that they have been subjected to a great elevating process. The conformability in these respects of the Devonian and Silurian in this representative district, shows that the elevation took place after the deposition of the Devonian, while the unconformability of the succeeding formation, the lower carboniferous, and other considerations to which we shall yet allude, show that the elevation took place prior to the latter period. In the Marshy Hope we find a similar order of things, showing that the elevation of Silurian and Devonian, and the formation of the mountains of this county, was *post* Devonian, and generally *pre*-carboniferous. The Silurias and Devonias of Arisaig with their synclinal arrangement *(vide Geology of Arisaig)* show the effects of a later upheaval, to which I shall yet refer. These formations which I have just examined are only a skirting of the mountains of the county. These mountains are mainly composed of metamorphic felspathic rocks of uncertain age and origin, or syenite and diorite, &c. Whatever may be their age and origin, I believe that as regards both they resemble the granite of the Nova Scotia auriferous zone. I also believe that while it is probable that the latter was elevated prior to the deposition of A, it may not have been exempt from subsidence coeval with that to which I have already referred. Be this as it may there can be little doubt that the felspathic rocks under examination, formed the bottom of the shallow sea in which strata A were deposited. That the metamorphism of the one was antecedent to the deposition of the other is evident, from the fact that organisms of A in closest proximity to the rocks in question remain unaltered, while at Arisaig the typical strata A in contact with trap of a subsequent period, are altered into a jaspideous rock, stratification and organisms being thoroughly obliterated *(vide Geology of Arisaig.)* Succeeding the sedimentary rocks already examined in the localities so often referred to, we find a certain amount of obscurity, and then sedimentary rocks of coarser material, which cannot be confounded with those preceding. Dr. Dawson has named these lower carboniferous; so far as I have observed in this county, they may be called *sub*-carboniferous. In these there are three degrees of coarseness observed. The finest strata occur at upper South river, succeeding the Devonian of the Lochaber series. Here the carboniferous approximate nearest in

fineness and colour to the preceding Devonian. Still, however, the difference between them is obvious, as the carboniferous is arenaceous, and the difference of inclination manifests unconformability. At Arisaig near McAra's brook, the carboniferous strata are much coarser than at upper South river, but of the same brownish red colour. Here we find the carboniferous sandstones forming mountains equal in elevation to the Silurian, having been upheaved by the trap which appears between the supposed Devonian up McAra's brook and the sandstone of the mountain. But the conglomerate is by far the most extensively distributed. We find it on the north-east side of Arisaig, and largely developed at Cape St. George. It is found at the south-east side of South river lake, occupying the same position in relation to Devonian here, as the fine brownish red sandstones to the Devonian at upper South river. It occurs on the south side of the Sugar Loaf north of the town, filling up the great break between this range and the Antigonish mountains. Here its width, or north and south extension, is about five miles. About six miles from the town it attains to a mountain elevation. It runs along the foot of the Antigonish mountains, and terminates apparently where it outcrops near the entrance to the Marshy Hope. I have already noticed this outcrop as succeeding the Devonian. This conglomerate unmistakably declares its age and origin. It was accumulated on the shores of the post Devonian sea, and formed from the felspathic rocks and slates of the mountains. Oxide of iron is its colouring matter, and streaks of green show the existence of thinly distributed carbonate of copper, while carbonate of lime largely agglutinates. The malachite is seen chiefly in the Sugar Loaf and Antigonish mountain conglomerate. Succeeding the upper South river lower carboniferous sandstones we have a thick bed of limestone, which probably owes its existence to organic agency, although it has not yet been found to contain organisms. On the road to Lochaber I found what appears to be a continuation of the same limestone, containing a deposit of beautiful brown ochre, and on the banks of the Ohio river the limestone continues; this is exposed in the bed and on the lofty banks of a small brook which runs into the river. Here the limestone is black and shaly, and contains numerous fossils, among which are *spiriferi sp.? producta spinosa*, and the *pygidium* of a *Phillipsia*. This is now the second locality

in the Province where the lower carboniferous limestone is found to contain the trilobite, the *Phillipsia Howi* having been found by Dr. How in the Kennetcook limestone in 1862. These limestones in the possession of this genus of trilobite, correspond with the mountain limestone of the British Isles, so that the one and the other are undoubtedly approximately contemporaneous. Succeeding the conglomerates of the Antigonish mountains and reposing directly upon them, we have limestone of considerable thickness; this can easily be traced continuously from the Marshy Hope to Morristown, a distance of about sixteen miles. In several places where it is quarried for building stone, large deposits of brown ochre are found, and the slabs are often coloured with films of carbonate of copper, and in one quarry where Braley brook issues from the mountains, I found some years ago imbedded in ochre several pieces of copper pyrites of considerable size.

Succeeding these limestones of the Antigonish mountains, we have an enormous bed of gypsum; its length is nearly equal to that of its associated limestone. It appears at the forks of James' river and the Ohio river; it passes over nearly in the course of James river until it reaches within one hundred paces of the limestones; its mountain side runs parallel with the limestones, Braley brook running between and along the bottom of the abrupt and lofty gypseous wall for about three miles. After parting with the brook the gypsum pursues its course until it reaches Right's river, nearly a mile north of the town. After an apparent break of two miles it again appears on the east side of the Sugar Loaf and proceeds onwards into St. George's bay, its land terminus being Ogden's lofty cliff.

Dr. Dawson shows this cliff in a plate in his *Acadian Geology*, where he examines very fully and satisfactorily the gypseous formation from Right's river to St. George's bay, so that in examining this part we traverse the ground which he has already rendered so familiar to the geologist. The breadth of this great gypsum deposit is duly proportioned to its length. It stretches from the mountains at North river, through the harbour and up the west side of South river, presenting at its southern terminus as well as on either side of the harbour and elsewhere in its course, a striking conical aspect. The southern terminus is seen by the traveller on the

right and left of the road to the Strait of Canso, about three and a half miles from the town. Again, beginning with the outcrop at Right's river, the pits in Trotter's pasture, and the great conical outcrop on the road to Braley brook settlement in front of the mountain break, the gypsum beyond a doubt passes under the town and to the south of it, until it outcrops on the banks of West river. Some years ago an attempt at sinking a well in the immediate vicinity in the west of the town disclosed the gypsum bed, and I there obtained specimens of fibrous gypsum of surpassing beauty. Associated with this bed of gypsum and apparently above it, we find limestones with lower carboniferous limestone, *brachiopoda.* In addition to this there are also numerous salt springs rising from this deposit; it therefore appears to be somewhat analogous to the *sub-*carboniferous of Michigan; and the Nova Scotia Salt Company, have thereby been induced to engage in boring operations, with the hope of discovering brine. Besides these beds of limestones there are also limestones of the same age at Doctor's brook in the Arisaig district, and in the trough between the Sugar Loaf range of mountains and the range between Malignant cove and Cape St. George. I have not yet been able to determine whether the latter belong to the north side of this trough or the south side. They appear to me to belong to the north side, like the gypsum which occurs at Ballantine's cove on the S. E. side of Cape St. George. At the side of the cape we have an interesting small section exposing sandstone strata having casts of shrinkage cracks, and others containing palæoniscus scales, and other strata containing carboniferous flora, calamites, and lepidodendria. These strata appear to be the equivalents of the strata on the south side of the same trough, some of which have attracted attention on account of their highly bituminous character. These also contain scales of palæoniscus and carboniferous flora, lepidodendria, cardaites. I expect to investigate this part of the country more rigidly if opportunity presents at some future time. I have yet to examine properly the remaining carboniferous or S.E. district of the county. In the meantime I have nothing to add to the observations which Dr. Dawson has already made on that district—(*vide Acadian Geology.*)

The questions now occur, by what agency have these post

MAP OF

Antigonish County,

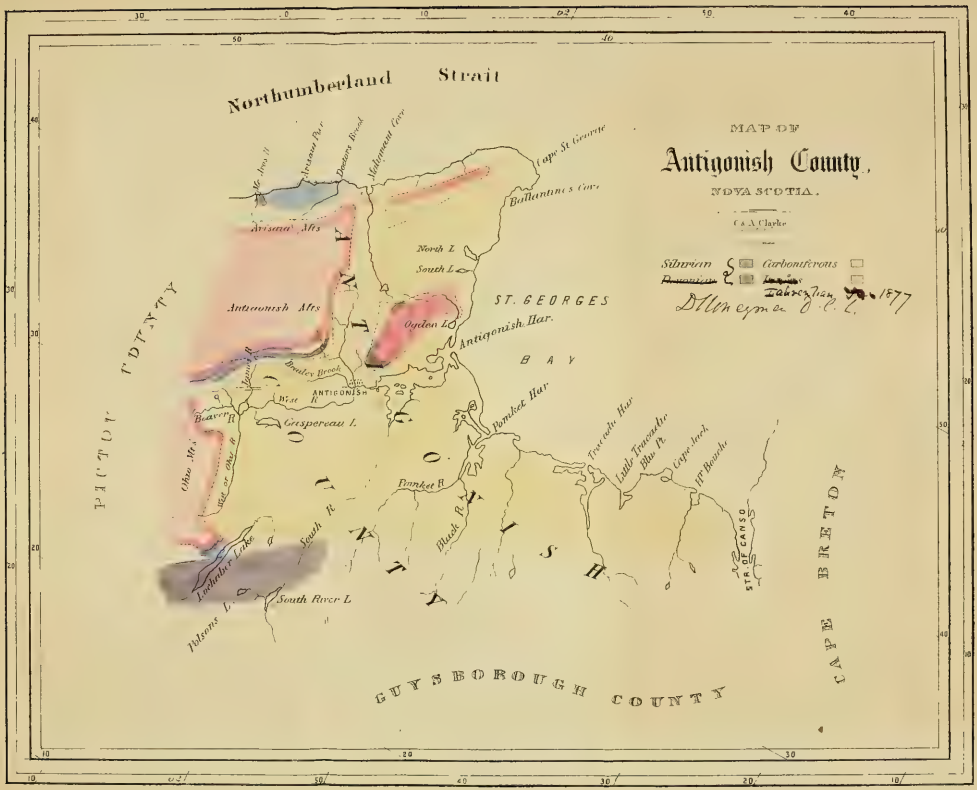
NOVA SCOTIA.

C. & A. Clarke.

Silurian ⎫ Carboniferous
~~Devonian~~ ⎭ ~~Igneous~~
Laurentian

1877

D. McLennan D. L. S.


MAP OF
Antigonish County,
NOVA SCOTIA.
C. A. Clarke
Silurian
Carboniferous
Tabrey Bay
1877
Northumberland Strait
Cape St. George
Ballantine's Cove
Arisaig Mts
North L.
South L.
Antigonish Mts
Ogden L.
ST. GEORGES
BAY
Antigonish Har.
Brierley Brook
West R.
ANTIGONISH
Beaver R.
Gaspereau L.
Pomket Har.
Pomket R.
Black R.
Tracadie Har.
Little Tracadie
Blue Pt.
Cape Jack
Wt. Bayshe
STR. OF CANSO
CAPE BRETON
PICTOU COUNTY
Otter Mts
West or Otter R.
South R.
Lochaber Lake
Hilsons L.
South River L.
GUYSBOROUGH COUNTY

Devonian strata been elevated, fractured and distorted? and when did this event happen? We have no difficulty whatever in ascertaining the cause by which the effects referred to were produced, and we seem to have no difficulty in determining that the event did not happen until after such and such a period; but the question of time remains unanswered. About the geological base of the carboniferous system we find trap rocks, intervening between these basal strata and the strata of a preceding age. These rocks appear in enormous mass in contiguity with the lower carboniferous conglomerates on the eastern side of South river lake, and they extend backwards to Polson's lake, disturbing the Devonian strata in that locality, as we have elsewhere observed. At McAra's brook, at Arisaig, we have already observed their occurrence between the Devonian and the lower carboniferous sandstones, elevating the latter to the altitude of lofty mountains. As we approach Malignant cove and near it, we observe on the road and either side, trap in closest contact with lower carboniferous conglomerate, the latter being metamorphosed into a hard jaspideous rock by the original contact with its igneous associate. These are seen in the same connection in Malignant brook, and crossing it in such a manner as to form the foundations of two mill seats, and the opposite abutments of a bridge; and in the same relation extending westward to Doctor's brook, forming an elevated ridge which runs between the older sedimentary or Silurian strata and the metamorphic mountains—(*vide Geology of Arisaig.*) In that paper it was shewn that this trap also bounded the other side of this silurian series from their eastern terminus, east of Doctor's brook, extending along the shore, and much altering strata A, as far as Arisaig pier, and being in the space intervening obscured by the sea, it reappears at the shore at McAra's brook, and up the brook as already indicated. From this it would appear that the upheaval of the Arisaig silurian group took place at the period of this trappean eruption, and that it was still in depths of the sea after the others of the same geological age were subaerial. I know not how we can otherwise account for the occurrence of the lower carboniferous limestones and associated strata of the same age at Doctor's brook, as indicated in my map and section,—(*vide Geology of Arisaig.*) It seems that this upheaval of sedimentary strata was at least post

lower carboniferous, but how long after this period it is difficult to determine. On the opposite coast of Cape Breton an interesting shore section at the new coal mines of Mabou, north of Mabou harbour, seems to illustrate the subject I am now investigating. We find in this section the lower carboniferous conglomerate of immense thickness, succeeded by a thick bed of rose coloured gypsum, succeeded by sandstones, with flora, a thick seam of coal, modiola shale, shale with calamites, clays with bands of clay iron stone, thick sandstones with flora, impure coal, clays and shales. The whole of these strata have been thrown into their present highly inclined position at the same time, and that too doubtless at the period of the trap eruptions in Antigonish county. I consider that the Mabou section represents geological time at least equivalent to that of the whole carboniferous formation of Antigonish county, and therefore conclude that all the carboniferous rocks of the county and the silurian of Arisaig assumed their present position at one and the same time. The formations in this county which we have thus examined, having become subaerial, continued so while deposition was in progress in the north of what is now the county of Antigonish. I have already brought under your notice lower carboniferous conglomerate, sandstone and limestone, with associated trap, at Malignant cove, Doctor's brook and McAra's brook. These undoubtedly are a part of a carboniferous series, which extending into Northumberland Strait and into the Gulf of St Lawrence, constitute part of the foundation on which Prince Edward Island triassic sandstone rests. In an age long posterior to the formation of the rocks of Prince Edward Island and their elevation, another very characteristic feature of the geology of the county was formed. I refer to the great deposits of drift which occur in every direction, obscuring the subjacent rocks and rendering the work of exploration often difficult and perplexing. The more prominent accumulations are the hills that occur in the break between the Antigonish mountains and the Malignant cove and Cape St. George range. At the north about one mile from the Malignant cove there are low mounds; gradually they increase in size and number, until at the distance of three miles south of the cove or at the south entrance of the break, the last of the series forms the elevated site of a Catholic chapel, which is conspicuous for several miles. On the banks of the Ohio river are numerous mounds

of the same character, and in and around the town of Antigonish are similar elevations of peculiar interest. My attention was specially directed to these about three years ago by the sinking of a well on the side of the one on which the old court house stands. After passing through several feet of gravel a bed of clay was struck which was peculiarly dry, compact and light in colour, containing imbedded fossil wood in abundance, well preserved, in the centre of which was phosphate of iron of a beautiful blue colour, which might be used as a pigment. On examining other mounds on the bank of Right's river I discovered sections of these exhibiting the same structure, and also having the same fossil. A great part of this superficial deposit is evidently derived from the subjacent rocks of the particular locality in which the deposit is found, and hence we naturally look at these deposits for information regarding the character of the prevailing rocks of the locality, especially in regard to the existence or probable extent of the distribution of these rocks. Of course great caution is to be observed in the application of this principle, owing to the fact that a part of this deposit and that possibly the larger, may consist of transported material which has been so triturated and rolled as to leave the question of its source open to all sorts of conjecture. In regard to the transportation of these I am disposed to consider that it was the effect of glacial agency. I have not yet been fortunate enough to discover so satisfactory indications in the region in question as we have elsewhere, of the existence of the glaciers. It will appear not at all astonishing that such a deposit derived largely from felspathic and calcareous rocks, and so extensively distributed, should give the county a character for agriculture. To a great extent, however, this character has arisen from a partial redistribution of the deposit, which I have just described, with the addition of organic matter, and in some instances with an addition of lime, gypsum, salt and felspathic constituents. This new deposit forms flats on the sides of rivers, past or present, and a great delta at their confluence. These are commonly called intervales. We have thus the rich and extensive intervale of the Ohio river and the Beaver meadow —the great intervales of West river and South river, and the smaller ones of Right's river, James' river and Braley brook, and what is by the old inhabitant often called the "great intervale," or the delta on which the town of Antigonish is chiefly built. These intervales,

although comparatively recent, are still doubtless of high antiquity, and were probably the haunts of the mastodon and his confreres, as the deposits are doubtless coeval with the intervale of Middle river, Cape Breton, which produced, upwards of thirty years ago, the thigh bone of *Mastodon Ohioticus*, now in the Provincial museum, and the flats of Baddeck, C. B., in which was found about seven years ago, the tooth of *Mastodon Ohioticus*, now in my own collection. It is the confidently expressed opinion of intelligent inhabitants who have been in the habit of observing landmarks for upwards of half a century, that the land is slowly subsiding. I have not yet ascertained precisely the grounds upon which this opinion rests. This point and others already indicated, may be the subject of notes on a future occasion.

Art. XII. Nova Scotian Conifers. By Colonel Hardy; Part I.

[*Read May* 3, 1866.]

A glance at a physical map of North America, will shew how the great prairies, extending diagonally through the continent, from the Gulf of Mexico to the shores of the great Slave Lake in the North-West, at this latter point appear to divide into two streams the evergreen forest, here composed solely of coniferæ, which forms a broad and continuous belt from the eastern shores of Labrador to the Pacific.

These fir forests in their northern extension, ever growing more stunted, gloomy and monotonous, at last merge into the treeless and snow-covered barren, where the small Arctic cariboo and musk ox obtain a scanty living on the lichens of the rocks, and grass-tufts of the valleys. Their character is sombre in the extreme; their growth and appearance indicate the severity and hardships of the climate; the twisted trunk, the bare and bent top, and the profuseness of the moss-beards clinging to the limbs of the spruce and scrub pine, the almost exclusive trees of the region, shew how slow has been their growth, and with what difficulty it has been attained. Dr. Richardson states that, on the borders of the Great Slave Lake,

four hundred years are required to bring the stem of the white spruce to the thickness of a man's wrist.

Leaving these desolate scenes, and tracing the influence of decreasing latitude and more genial climate upon the great belt of coniferæ where, skirting the prairies, it enters the lake districts of Canada, we find that at about the neighbourhood of Lake Winnipeg the forest is diversified by the accession of several species of deciduous trees, the elm and the ash; further south, by the various descriptions of maples, oaks, and beeches; and, at length, by the shores of Superior, the character of the Canadian forest becomes fully developed, exhibiting that beautiful admixture of deciduous trees with the various pines and spruces, which constitutes its picturesque grandeur.

Embracing the Canadian Lakes and the shores of the St. Lawrence, this woodland district stretches away to the Atlantic seaboard, and covers the provinces of New Brunswick, Nova Scotia, and Prince Edward Island, including a large portion of the Northern States. This large tract of forest has been termed by Dr. Cooper in his admirable monograph on the North American forest-trees, the Lacustrian Province, from the number of its great lakes, and is chiefly characterized by the predominance of evergreen coniferæ.

The consideration of this family, extending over so large a portion of our North American colonies, involves many subjects of great importance as to the physical aspects and climate of the country, the influence of its forests on rainfall and springs, on the vegetation and on the health of its inhabitants, which cannot be discussed this evening. Nor can we notice, more than briefly, another interesting topic in connection with our subject—the extreme geological antiquity represented by the fir-tree. Hugh Miller states, that he found a fossil of coniferous lignite in the Lower Old Red Sandstone, and that Pine forests existed, and there was dry land, where it had been previously thought that all was covered by the ocean.

Conifers formed a leading feature of the coal formation; and, though all the ancient species, up to the Post Tertiary period, have perished, the type is still continued in all its low state of organization.

The animals characterizing the North American fir forest are all, likewise, of most ancient type; especially the musk ox, the

reindeer and the moose, whose ancestors have doubtless lived contemporaries with the mammoth in the earlier period of the Post Tertiary.—" America" says Hugh Miller, " though emphatically the New World in relation to its discovery by civilized man, is, at least in these regions, an old world in relation to geological type, and it is the so called old world that is in reality the new one.

A. Nigra (*Poir*), Black Spruce, Double Spruce.

Leaves short ($\frac{1}{2}$ in. by $\frac{2}{3}$ in. long) rigid, dark green; cones ovate or ovate oblong (1—$1\frac{1}{2}$ in. long) the scale with a thin and wavy eroded edge. *A. rubra*, a northern form.

The Black Spruce is one of the most conspicuous and characteristic forest trees of North Eastern America, forming a large portion of the coniferous forest growth and found in almost every variety of circumstance. Sometimes it appears in mixed woods of beautiful growth, of great height and its numerous branches drooping in graceful curves from its apex towards the ground, which they sometimes sweep to a distance of twenty to thirty feet from the stem, the summit terminating in a dense arrow head, on the short sprays of which are crowded heavy masses of cones. At others it is found almost the sole growth, covering large tracts of country, the trees standing thick with straight clean stems and but little foliage except at the summit. Then there is the black spruce swamp where the tree shows by its contortions, unhealthy foliage and stem and limbs shaggy with usnea, the hardships of its existence. Again on the open bog* grows the black spruce, scarcely higher than a cabbage sprout—the light olive green foliage living alone on the compressed summit, whilst the grey dead twigs below are crowded with pendulous moss; yet even here, amidst the cold sphagnum, Indian cups, and cotton grass, the tree lives to an age which would have given it a proud position in the dry forest.† Lastly in the fissure of a

*The Black Spruce assumes a singular appearance in these swamps. The tree, seldom exceeding 30 feet in height, throws out its arms in the most tortuous shapes, suddenly terminating in a dense mass of innumerable branchlets of a rounded contour like a beehive, displaying short, thick, light green foliage. The summit of the tree generally terminates in another bunch. The stem and arms are profusely covered with lichens and usnea.

†Indeed these groves of miniature trees in bogs where the sphagnum perpetually bathes their roots with chilling moisture, have a very similar appearance to Brussels sprouts on a large scale. The water held in the moss is always cold: on May 5th, 1866, the tussacs of sphagnum were frozen solidly within two or three

granite boulder is to be seen its hardy seedling, and the little plant has a far better chance of becoming a tree than its brother in the swamp; for one day, as frost and increasing soil open the fissure, its roots will creep out and fasten on the earth beneath.

As a valuable timber tree the Black Spruce ranks next to the Pine, attaining a height of 70 to 100 or even 150 feet, it forms excellent material, strong and elastic, for spars and yards of vessels, and is converted into all descriptions of sawed lumber—deals, boards, and scantlings. From the young sprays of the Black Spruce is prepared the decoction, fermented with molasses, which is the celebrated spruce beer of the American settler, a cask of which is always kept by the good farmer's wife in the hot, thirsty days of haymaking.* To the Indian, the roots of this tree which shoot out under the moss to a great distance, are his rope, string and thread: with them he ties his bundle, fastens the birch-bark coverings to the poles of his wigwam, or sews the broad sheets of the same material over the ashen ribs of his canoe.

As an ornamental tree in the open and cultivated glebe, the Black Spruce is very appropriate: the numerous and gracefully curved branches, the regular and acute cone shape of the mass, the clear purplish-grey stem and the beautiful bloom which the abundant cones assume in June, all enhance the picturesqueness of a tree which is long-lived, and, moreover, never outgrows its ornamental appearance unless confined in dense woodland groves.

The bark of the Black Spruce is scaly, of various shades of purplish-grey, sometimes approaching to a reddish hue, hence doubtless, suggesting a variety under the name of Red Spruce, which is in reality a form depending on situation. In the latter, the foliage being frequently of a lighter tinge of green, strengthens the supposition. No specific differences have, however, been detected between the trees.

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inches of the surface. The centre of these bogs, often called cariboo bogs by reason of this deer frequenting them in search of the lichen, *cladonia rangiferinus* is generally quite bare of spruce clumps, which fringe the edge of the surrounding for the trees increasing in height as they recede from the open bog.

* Essence of spruce is obtained by evaporating the decoction of young shoots in water mixed with sugar and molasses, to the consistence of honey.

A. alba, Mich. (*White Spruce.*)

The White Spruce, or Sea Spruce of the Indians, is, as has been already stated, a conifer of an essentially boreal character. Indeed in its extension into our own woodlands it appears to prefer bleak and exposed situations. It thrives on our rugged Atlantic shores, and grows on exposed and brine-washed sands where no other vegetation appears, and hence is very useful, both as a shelter to the land, and as holding it against the encroachment of the sea. Its dark glaucous foliage assumes an almost inpenetrable aspect under these circumstances. On the sandy shores near the entrance of Musquodoboit harbour there is a grove of White Spruce, which, constantly exposed to S. W. gales, have become so compressed and flattened at the tops, which lean inland from the sea at scarcely ten feet elevation, that a man can easily walk over them as on a platform, and the shelter beneath is complete.*

The Balsam Fir growing in these situations assumes a very similar appearance in the density and colour of its foliage and trunk to the White Spruce, from which, however, it can be quickly distinguished, on inspection, by the pustules on the bark and its erect cones. In the forest the White Spruce is rare in comparison with the Black, whose place it however altogether usurps on the sand hills bordering the limit of vegetation in the far north-west. The former tree prefers humid and rocky woods. The timber is used in frame work. I know of no peculiar properties of this tree in an economical point of view, except, that the Indians affirm that the inner bark or *liber* is useful to chew as a demulcent in the case of colds.

General Description.—Leaves pale or glaucous; cones cylindrical, about 2 inches long, the scales with an entire edge. Leaves $\frac{1}{2}$ to $\frac{3}{4}$ inch in length placed on all sides of the branches. The cones are first of all light green, afterwards tinged with pink, and on ripening change to a very pale brown.

A. Canadensis, Mich. (Hemlock Spruce.)

Leaves linear, flat, obtuse $\frac{1}{2}$ inch long; cones oval, of few scales, little larger than the leaves, $\frac{3}{4}$ inch long.

The Hemlock Spruce has a wide range in the coniferous woodlands of North America, extending from the Hudson Bay territory to the mountains of Georgia. This great southerly extension of the

* The White Spruce is in frequent groves on the slopes of Point Pleasant. There are some trees of this species nearly 60 feet in height on McNab's Island.

northern forms of trees on the south-east coast, is due to the direction of the Alleghanian range, which, commencing in our own Province of vegetation, carries its flora as far south as 35° north latitude, elevation affording the same conditions of growth as distance from the equator.

The Hemlock is found as a common tree throughout Nova Scotia, loving rich mossy hill sides in the neighbourhood of lakes, though generally mixing with other evergreens in all situations. It is found, however, of heaviest growth (70–100 feet), and in large groves, principally in the former situation, and here vies with the White Pine in the gigantic proportion of its trunk, which grows like a mosaic column, throwing out its first branches gnarled and contorted at a height of 60 feet from the ground. The foliage is light and feathery, resembling that of the yew, and in the old forest tree clings round the summit above in dense masses, from which protrude the twisted limb by which the column is abruptly terminated.

Perched high up in its branches may often be seen, in winter time, the sluggish porcupine, whose presence aloft is first detected by the keen eye of the Indian through the scratches of its claws on the trunk, in ascending its favourite tree to feed on the bark and leaves of the younger shoots.

Large groves of Hemlock growing together in the sloping woodside present a noble appearance; their tall straight stems resemble the pillars in the aisle of an old abbey; the ground beneath is generally free from undergrowth, and deeply covered with a soft carpeting of moss, and affords great ease to the foot-sore hunter. One can see far through the far shady grove of giants, and the softened light, entering through the thick foliage above, gives an air of pleasing mystery to the interior of these vast forest cathedrals.

The timber of the Hemlock is lightly appreciated for building purposes, being brittle and shakey, and coarse-grained. It is used extensively for wharf and fence posts, being able to resist the action of water a long time, and also has come into demand for railway sleepers. The late Dr. Gesner states, that granaries and grain bins made of Hemlock are not attacked by mice. The bark, which possesses highly astringent properties, is much used in America for tanning, almost entirely superseding that of the oak. It is very

scaly, and, though light grey outside, shews a rich red-brown tint when chipped. The sojourner in the woods seeks the dry and easily detached bark which clings to an old dead Hemlock, as a great auxiliary to his stock of fuel for the camp-fire; it burns readily, long, and emits an intense heat; and so fond are the old Indians of sitting round a small conical pile of the ignited bark in their wigwams, that it bears in their language the sobriquet of "the old Grannie".

The Hemlock, as a shrub, is perhaps the most ornamental of all the North American evergreens. It has none of that tight, stiff, old-fashioned appearance so generally seen in other spruces: the graceful foliage droops loosely and irregularly, hiding the stem, and, when each spray is tipped with the new season's shoot of the brightest sea-green imaginable, the appearance is very beautiful. The young cones are likewise of a delicate green.

The spray of the Hemlock is often used by the woodsman in hard times as a decoction in water in lieu of tea, as also is the ground Hemlock. The bark is very ornamental for decorating garden flower baskets in a rustic style.

A. balsamea—Marshall—(Balsam Fir). Canada Balsam or Balm of Gilead Fir,

Leaves narrowly linear; cones cylindrical, large, violet-coloured; the bracts obovate, serrulate, tipped with abrupt and slender point, slightly projecting upwards. Leaves 1 in. or less in length, narrower and lighter-green than those of European or Silver Fir. Cones 3 to 4 in. long, 1 in. broad, the scale very broad and rounded.

So very similar is the American species to the Silver Fir (*Picea*) of Europe, that, when visiting England, I have had to search the stem for the characteristic pustules of balsam, found on our fir, before assuring myself of the difference. The general appearance of the trees is very analogous: the same silvery lines on each side of the midrib under the leaf, which glistening in the sun as the branches are blown upwards by the wind, gives the tree its name. The leaves, however, of the American species are neither so broad nor so dark in colour as those of *Picea*. Dr. Cooper assigns the range of the Silver Fir, N.E. S.W, between the Labrador and the mountains of Penn. It inhabits moist woods and, though growing to a large size, is a short lived tree—often falling before a heavy gale, and shewing a rotten heart. This Province and New Bruns-

wick, perhaps, afford the finest specimens of this tree. Here I have seen it growing to the height of 60 feet.

The large, erect, sessile cones of the Balsam Fir are very beautiful in the end of May, when they are of a light sea-green colour, which, changing in June to pale lavender, in August assumes a dark slaty tint. They ripen in the fall, and the scale being easily detached, the seeds are soon scattered by the Autumnal gales* leaving the axis bare and persistent on the branch for many years. In June each strobile is surmounted with a large mass of balsam exudation.

The summer of 1864 was marked as a most fructiferous season amongst all species of coniferæ on the American continent. The casual observer passing along the roads could not help observing the masses of brown cones which everywhere burdened the tops of the pines and spruces, and from which the Indians augured an unusually hard winter, through much the same process of reasoning that the English countryman prophecies a rigorous season from an abundant crop of haws and other autumnal hedge fruits. The hard season did not arrive, but the immense crop of cones killed a large number of trees, especially of the species under consideration. If not actually killed, many instances of the Silver Fir with a dead leading shoot, or with one just recovering its vitality may be constantly seen by any roadside observer. In the former case, a new leader, elected from the nearest tier of branchlets, is already lifting its head to continue the growth of the tree, and the latter instance, in which all the surrounding shoots and foliage have been vitally drained by the exhausting cone-crops, may be supposed to account for the long spaces or intermissions between the lateral branches of firs, at certain intervals up the main stem which are often to be observed.

The Silver Fir is remarkable for the horizontal regularity of its branches, and the general exact conical formation of the whole tree. An irregularity in the growth of the foliage, similar to that occurring in the black spruce, is frequently to be found in the fir. A contorted branch, generally half-way up the stem, terminates in a multitude of interlaced sprays which are, every summer, clothed with very delicate, flaccid, light-green leaves, forming a beehive

* The cones of other species of Ashes and Pines generally do not ripen until the 2nd year, whilst the expanded strobile remains attached to the tree for long after.

growth like that of the spruce. It may be always noticed, however, that whilst the spruce growth of this nature is persistent in its foliage, that of the fir is annually deciduous.

The Silver Fir is a graceful shrub up to a certain age, and its sprays, soft and flattened, form the best couch in the woodman's camp. The bark of the tree readily peels in summer, and is used in sheets to cover the lumberer's shanty, which is now built in prospect of the winter's campaign. The resinous fluid contained in the pustules is the Canada Balsam of commerce.

I am not aware that any exportation of balsam, or, indeed, of any resins is made from Nova Scotia. All such productions might be made profitable, as prices have recently been high in consequence of the American war, commerce having been plentifully supplied with tar, pitch, resin and turpentine from North Carolina and other states of the Confederacy. It must be noticed however, that the pines of the Southern States are not found in these Northern latitudes. They are the long-leaved or yellow pine (*P. Palustris*), and the loblolly or old field pine (*P. tæda*). Our common *P. strobus* affords but little resin. *P. resinosa* and *P. Rigidsa* or pitch pine are both resinous woods, as is also the larch. It is much to be regretted that so many thousand acres of these woods are yearly disappearing by fire and through wanton waste, whilst a source of profit like the above is still allowed to slip by unnoticed.

In conclusion I will append a few remarks on the transplanting and acclimatization of evergreens, a subject which I am glad to observe has been very practically studied of late years. It is patent to every one, resident in Halifax, that we are now compelled to suffer everywhere on this bleak peninsula for the wholesale destruction of trees on the part of the earlier inhabitants. The bitter winds experienced on a winter's drive over the common, and the roads to the N. West Arm and Three Mile House, oftentimes denuded of snow, which is at others piled in drifts, whilst the sleighing is excellent in both town and country, point, as a cause, to the cutting away of the road-side fringe of sheltering trees; and now the slow remedy of replanting must needs be applied. As a winter shelter the evergreen tree is naturally adopted, though in former times its association with the rigor of the climate doubtless resulted in its wholesale downfall at the hands of the early settlers, and there is

still a strong tendency about us to obliterate the evergreen vegetation.

Such however, happily, is not the exclusive spirit of our age, and I cannot refrain from adducing, as an example, the following letter which appeared recently in the local press, headed "Nova Scotia Evergreens":—

To the Editor of the Sun.

SIR,—To my fancy, there is not a tree that grows in the woods of Nova Scotia, that looks so graceful and becoming as evergreens near a dwelling house in winter. They refresh the eye, protect the building and small shrubbery, and give the homestead a snug, social aspect. They also bring up pleasant memories of summer and green fields, and, almost unconsciously to the beholder, promote healthful imagination and a refreshing quiet and repose.

Those who have tried to beautify their houses with Nova Scotia evergreens, mostly confess that they have failed in their object. There is not a tree that grows in our forest that is so hard to raise by transplanting as the Black and Red Spruce and the Balsam Fir; and yet, if properly treated, they will grow as freely as any plant of the forest.

I would say to those who love to see their own native evergreens growing around their dwellings, be not discouraged by any past attempts; success will be attained if they perform the work according to my plan and treatment.

Cultivated soil will not answer for evergreens, unless it is poor, and the subsoil clay or gravel is near the surface. The best soil for black or red spruce is the common light yellow clay or gravel, free from iron rust, and well mixed with greywacke rock and whinstone. If the clay should be mixed with fragments of iron-stone and blue slate, the White Pine, the Hemlock, and the Balsam Fir should be planted. The limestone soil is more suitable for White Cedar. Peaty or vegetable soil is best for the Larch.

The last week of April, and the first week of May, is the best time to remove evergreens for transplanting; then the soil is very soft, and the young trees easily taken out without fear of bruising their tender roots. Strong young plants can always be found on the outskirts of the woods. The average height of the plants should range from a half to two and a half feet, thickly set, with close branches and free from white moss. The plants should be removed on a dull day;—put them into bundles of one dozen each, and tie them with a soft string. and if a trench is already prepared, place the trees in just as they are, in bundles, close together, and cover the roots well with the clay; let them remain there until the tender feeders of the roots grow white. About the 1st of June you can remove the string and transplant them for a hedge or clump around the dwelling house, or elsewhere. They must be well protected from the high winds; the north-east and easterly winds are more injurious than any other.

The Balsam Fir or Silver Fir should be planted by themselves. No pruning is required for ten or twelve years, and then sparingly.

No other class of trees should be planted near the Evergreens, for they always grow more rapid when they are some distance from any other trees. It is labour in vain to transplant Evergreens in the fall of the year.

Halifax, Nov. 27, 1865. F. McKAY.

Our writer recommends transplanting evergreens in the spring,

saying it is useless to attempt it in the fall. On this point, however, the evidence which I have collected from most local authorities on the subject tends to reverse his conlusion ; as it is generally admitted that the very best time for transplanting these trees is in the end of May or beginning of June—just when the young shoots, having broken their capsules, are conspicuous by their new bright-green colour. The plant now seems to be full of energy, and will adapt itself to circumstances in order to continue its efforts more quickly then when partially dormant. Very early in the season is perilous, as the Fir having so large an amount of evaporating surface is more apt to receive injury from the cold drying wind of early spring than deciduous trees. Spruces should be placed in the ground with their long diverging roots as near the surface as possible, merely placing around them the upturned sod.

Planting by seed is the usual plan for growing evergreens in the English and Scotch nurseries. The young plants have excellent roots, and are much more easily removed. The success of the Fir plants which have come over to this country is very noticeable. and the Norway Spruces on the Common, the Scotch Firs and Larches in the Cemetery and Horticultural Gardens, are much more forward than any of our indignious transplants. These trees appears to thrive admirably in this country : the English Larch is now everywhere in blossom, (May 7th,) with budding foliage, whilst our own species still seems wrapped in its winter sleep; the leading shoots of last season's growth on the Norway Spruce are nearly a yard in length, when the indigenous transplant rises but a few inches.

Art. XIII. On the Land Birds of Nova Scotia. By A. Downs, *Cor. Memb. Zool. Soc. of London.*

[*Read May* 3, 1866.]

Having in my last paper completed the list of the Birds of Nova Scotia as far as the warblers, I now proceed with the wrens, creepers, sparrows, &c ; but as our Institute has an abundance of matter for insertion in the next number of Transactions, I will not trespass too much by making this paper a lengthy one, but will reserve my additional remarks for next session, when, if life and health be spared me, I hope to complete the whole of the land birds.

I wish to remark, however, in regard to my last paper, that as European naturalists have been misled by my having given our barn swallow as *Hirundo rustica*, it would probably be better to insert Wilson's specific name *Americana* instead. Most of the European and American birds are perfectly distinct, although some authors have given them a similar name, and without thought I repeated the error.

Black and White Creeper—(*Certhia varia*).—This pretty little bird with its black and white streaked plumage so clearly defined, is somewhat abundant, and generally observed in company with the warblers and arriving about the same time. Its nest is very difficult to find.

Brown Creeper—(*Certhia familiaris.*)—This bird which is considered to be identical with the European Brown Creeper is by no means abundant. I have shot specimens in the vicinity of Grand Lake, that famous locality for birds of all kinds, and have also seen it once on my own property in the village. I think it breeds about Grand Lake.

Winter Wren—(*Troglodytes hyemalis*).—Nearly always found inland. I have seen it about Grand Lake, and in the neighbourhood of Kentville, but never about Halifax. This bird has a very powerful song taking into consideration its small size, and at times makes the forest ring with its pleasing note, It is solitary in habit, and, unlike some of the wrens which court the society of man, appears to shun it. You may see it in some secluded part of the forest, hopping about old fallen tree trunks and endeavouring to screen itself from observation.

Ruby Crowned Wren—(*Regulus calendula*).—This is not a common bird, and partakes of the habits of the former species in keeping away from cultivation, and in power of song. I have shot a specimen in Byer's swamp in the village.

American Gold Crest—(*Regulus satrapa*).—This nimble little bird is a constant resident in the Province. It breeds in the denser parts of the forest. In winter time when all nature appears to be in a deep sleep the gold-crest and the black-cap-tit flit from tree to tree in search of insect life, scanning the cracks and crevices, from which they appear to obtain enough for their support.

Black-Cap-tit—(*Parus atricapillus.*)—Very common in win-

ter time. It breeds in the Province in holes of trees. I once observed one in the act of taking some sheep's wool for its nest. The wool was beneath a stick on the highroad, and the bird was endeavouring to collect all the wool, which it did by carding it out and surrounding its whole head with a perfect ball of the fuzzy material. Country people say, that when he cries "sweet weather, sweet weather," a storm is brewing. It is commonly known as the "*chick-a-dee*" from its oft repeated note, which sounds like the words "chick a dee dee dee". It delights to feast on fat of any kind, and I saw it light upon candle moulds set out to cool and pick out the grease. I once saw one enter a good sized marrow bone and disappear entirely in the hollow within. It becomes very tame when fed from a window, and during the past hard winter Mrs. R. G. Fraser, had a perfect flock of black-cap-tits and other birds, which regularly came to be fed night and morning.

Hudson's Bay Tit—(*P. Hudsonicus.*)—Although similar in habit to the preceding species it is not so common, but may occasionally be seen in company with it. It breeds in Nova Scotia.

Solitary Vireo—(*Vireo solitarius.*)—This rare bird is almost unknown to me, although I believe it breeds in some parts of the Province.

Warbling Vireo—(*V. Gilvus.*)—Common. It breeds about the village, generally on the slopes of the hills among the birch groves.

Blue Bird—(*Gialia Wilsonu.*)—This handsome bird is only occasionally seen here, being out of its usual latitude so far north. I once saw four on a willow tree near Kidston's house, and got a box and fixed it up like they do in the United States, but they never took possession.

Cedar Bird, or Waxwing—(*Bombycilla Carolinensis.*)—Generally appears here about the first day of June when the apple blossoms are out. It feeds upon fruit and insects, and is a fearless bird allowing a person to come close to it. It breeds in the village, a boy having brought me a nest taken near the church school house.

Bohemian Waxwing.—This bird occurred here in the winter of 1864–5. A flock was seen near the Three Mile House, and Mr. Bellis shot some specimens. This is the only instance on record of its appearance in the Province so far as I know.

Song Sparrow—(*F. melodia.*)—This is the most common species we have. It breeds about clearings, making a nest on the ground, in which it lays four blotched eggs. In habit it resembles the wren, hopping about faggot heaps and jerking its tail up and down: indeed I may say it supplies the place of the English wren in Nova Scotia. A few stop all winter, and I have heard them singing in February, in the Hon. Edward Kenny's garden in the city. Some I have in confinement sing at night. Boys call it "Spring Bird." Its note sounds like "chink, chink, chol vo ree: old Bill Pickett sha'nt have me."

White-throated Sparrow—(*F. Pennslyvanica.*)—Its welcome note to the fisherman on the lakes is first heard about the end of April. It builds its nest in tufts of ground juniper in low spots, and lays four eggs. I once heard the cry of this bird in distress making a pitiful noise, and on arriving at the spot saw a red squirrel with a young sparrow in his mouth. I threw a stone at him and he let go his prize, when I found that he had eaten its head off. This squirrel will also rob the nests of the migratory thrush, taking eggs and young. This bird from its note is called "Poor Kennedy's Bird."

Bay-winged Sparrow—(*Emberiza graminea.*)—This is a very rare species. Capt. Blakiston and I had great work trying to get a specimen.

Chipping Sparrow—(*E.socialis.*)—This bird appears to become more common every year as the country becomes cleared. In the United States it is very common, hopping about the roads in the city parks and other frequented places, almost under the feet of passers by. It breeds in this Province in evergreen trees, a pair or so at my place; in the States it builds in the cedar; it is only of late years I have seen this bird about Halifax.

Tree Sparrow—(*E. Canadensis.*)—This is one of the birds which visit us only in winter, when it may be seen on the snowy roads picking at horse droppings. As spring advances it leaves us for the far north, where removed from danger it builds its nest and rears its young in security.

Savannah Sparrow—(*E. Savannah.*)—Not a common bird here. It is evidently a ground species, as I have never observed it in a tree. A few breed in the province every year.

Swamp Sparrow—(*Fringilla Palustris.*)—This is a very rare species, observed but seldom, and I know nothing of its habits.

Snow Bird—(*Junco hyernalis.*)—This is probably with the exception of the robin, the most familiar bird in Nova Scotia, being the only one that is seen in our yards and gardens at all times. Some call it the "blue bird" from its slate coloured back. A few stay all winter and come into out-houses to search for food. Some years ago, a pair of these birds made their nest on a beam in an unfinished house, in Lockman street, where a carpenter was continually at work, but his labour did not appear to interfere with their incubation. When a stranger, however, came in, they at once flew off and remained until his departure. They finally hatched their four young ones and took them away. Their usual nest is on the ground, a situation frequently taken advantage of by the spotted snake, (*Coluber sirtalis,*) which frequently makes a meal of the young. I have some in confinement.

Snow Bunting—(*E. nivalis.*)—This well known bird arrives with the first snowstorms of winter, and leaves about the beginning of March. The citadel hill is a favourite resort of this northern species, and it appears to prefer the most exposed situations. It has always been a mystery to me where these birds shelter themselves at night, or during a heavy snow storm.

Purple Finch—(*Fringilla purpurea.*)—Very common. It is easily trapped; its appearance and song causing it to be kept in cages. It loses the red plumage in confinement and becomes yellowish. The young birds are grey until the second year, when they assume the mature red plumage. This is the bird called by bird fanciers red linnet and the grey linnet—they are the same.

Northern Redpole—(*Linaria borealis.*)—In former years this bird was more abundant than it is now. It visits us in flocks in winter. Mr. J. M. Jones informs me that he has shot this northern bird in winter time in the Bermudas. All go north in spring.

Pine Finch—(*L. Pinus.*)—A constant resident all the year, plenty in winter. It is a very familiar bird allowing a person to come close to it without showing any fear. One I have in confinement will come and sit on my finger. It feeds principally on the seeds of the *coniferæ,* but in confinement takes common bird seed. W. Winton found a nest in March some years ago with eggs in it, the high winds blew the eggs out of the nest.

Indigo Bird—(*Fringilla cyanea.*)—Very rare, only a straggler occurring now and then.

American Goldfinch—(*Carduelis tristis.*)—This bird is common inland, especially about Truro and Windsor, but is rare in the vicinity of Halifax. It breeds here and a few remain during winter, changing at that season to an olive colour. Its call note is pretty and something like that of a canary.

Pine Grosbeak—(*Corythus enucleator.*)—Common during the winter, attracting attention by the rose coloured plumage of the male bird. It is very tame, sitting on a bough on the road side while a passenger goes by. Some years ago I shot one of these birds behind Mr. James Forman's house, a female. No sooner had the lifeless body fallen to the ground than the male bird flew down and began to protect it by placing dead leaves around. The scene was so touching that I would never wish to cause its enactment again. Mr. Foreman tells me several of these birds have frequented his garden during the past hard winter. All leave here in spring for the North. I am told it breeds in Newfoundland.

Rose-breasted Grosbeak—(*Coccovorus ludovicianus.*)—This is a summer bird with us, and both for plumage and song is kept in cages. It is to be found about Mount Thom, near Truro, and also at Pictou, and I am told equally so at Prince Edward Island. We rarely see it about Halifax. It usually frequents hardwood hills, and breeds about Grand Lake, and other parts of the Province that abound with large hard wood trees.

White-winged Crossbill—(*Loxia leucoptera.*)—During some years it is abundant, while at other times it is rare. It breeds in the Province and feeds on the seeds of the *Coniferæ.* Mr. Henry Piers assures me that he has found a nest of this bird with young in it in midwinter, it was in a hollow tree that was chopped down for fire wood.

Common Crossbill—(*L. curvirostra.*)—The same description will answer for this species. I may add that it has always been a puzzle to naturalists in what position these birds breed, it is supposed to be identical with the European.

In conclusion, I wish to make a few brief remarks pertaining to the arrival and departure on their migrations, of the various birds which visit our Province.

Nova Scotia is very favourably placed for observers, and I feel confident that if a more extended series of observations in this respect were made, we should become possessed of valuable information now unknown to us. Vast flights of wild fowl pass and repass over this peninsula in spring and autumn, to and from the coasts of Labrador and Newfoundland, and even still farther north; and it would be extremely interesting to ascertain with what precision such arrivals take place each year, and whether an early spring or a late autumn have any particular influence upon such movements. In my humble opinion I am inclined to think that such casual occurrences have little effect upon the feathered tribe, but that they move north at the close of winter and south at its commencement, with great regularity, guided alone by that wonderful instinct which is implanted within them by their Allwise Creator.

APPENDIX.

ABSTRACT OF METEROLOGICAL REGISTER, HALIFAX, NOVA SCOTIA, LAT. 44° 39′ 26″ N., LONG. 63° 36′ 40″ W.

1865.	Thermometer. Max.	Mean.	Min.	Range.	Barometer. Max.	Mean.	Min.	Range.	Winds. Most prevalent.	Least prevalent.	Weather, &c. Rain fell on	Snow fell on	Hail fell on	Fog on	Aurora Borealis	Solar halos on	Lunar halos on	Lightn'g.	Thunder.
											Days	Days	Days	Days	Night	Days	Nights	Days	Days
January.....	49°	22°	4°	45°	30·26	29·55	28·83	1·43	N.W. & S.W.	E.	8	13	...	5	4	1	3	...	...
February...	44	24	8	36	30·25	29.63	29·09	1·16	N. E.	S.	5	14	1	3	5	1	...	...	...
March.....	50	34	11	39	30·35	29·75	28 95	1·40	N.W. & S.W.	E.	12	5	1	2	6	...	...	1	1
April.....	64	40	25	39	30·22	29·80	29·15	1·07	S. W.	E.	14	2	...	6	4	2	3	...	...
May.....	78	49	29	49	30·11	29·64	29·12	99	S.E. & S.W.	E.	17	1	...	15	2	...	2	1	3
June.....	74	58	35	39	30·10	29·73	29·46	·64	S. W.	E.	8	...	...	5	2	...	...	1	...
July.....	84	60	49	35	29 98	29·60	29·39	·59	S. W.	E.	14	...	...	7	4	1	1	1	1
August.....	85	63	45	40	30 05	29·67	29·34	·71	S. W.	E.	9	...	...	8	11	...	...	...	...
September..	81	57	35	46	29·99	29·72	29·40	·59	N. W.	E.	8	...	...	1	5	...	1	1	...
October.....	72	44	24	48	30·18	29·48	28·73	1·45	N. W.	E.	15	2	1	4	8	...	...	1	1
November..	63	39	16	47	30·07	29·60	29·07	1·00	N. W.	S.	16	6		1	3	...	2	...	...
December..	51	24	6	57	30·10	29 60	28·51	1·59	N. W.	S.	10	9	...	3	1	...	...	...	...
Yearly..	...	43	...	91	...	29·65	...	1·84	...	...	...	...	...	...	...	...	...	...	...

MONTHLY AND YEARLY MEANS AND RANGE FOR 1863, 1864 & 1865, HALIFAX, NOVA SCOTIA.

	THERMOMETER.						BAROMETER.					
	Monthly Mean.			Monthly Range.			Monthly Mean.			Monthly Range.		
	1863.	1864.	1865.	1863.	1864.	1865.	1863.	1864.	1865.	1863.	1864.	1865.
January	30°	23°	22°	42°	54°	45°	29·60	29·61	29·55	1·60	1·17	1·43
February	23	26	24	53	51	36	29·80	29·81	29·63	1·55	1·67	1·16
March	25	28	34	45	36	39	29·66	29·47	29·75	1·17	1·19	·40
April	38	36	40	41	43	39	29·66	29·63	29·80	1·24	·86	1·07
May	47	48	49	46	38	49	29·66	29·64	29·64	·68	·76	·99
June	54	57	58	36	55	39	29·64	29·66	29·73	·71	1·00	·64
July	65	62	60	35	33	35	29·79	29·73	29·60	·60	·54	·59
August	64	64	63	34	34	40	29·75	29·72	29·67	·97	·71	·71
September	58	56	57	42	33	46	29·81	29·72	29·72	·96	·98	·59
October	51	46	44	36	34	48	29·84	29·56	29·48	·84	1·04	1·45
November	40	39	39	47	37	47	29·64	29·68	29·60	·99	1·05	1·00
December	26	27	24	36	50	57	29·70	29·55	29 60	1.12	1·78	1·59
Yearly	44	43	43	96	97	91	29·71	29·65	29·65	1·75	1·78	1·84

THE following remarks upon the Red Indians of Newfoundland, by Mr. ELIAS MARETT, are contained in a letter to the PRESIDENT :

"213 GOWER-ST., ST. JOHN'S, N. F.,
October 15, 1865.

"*My Dear Sir*,—

"Sometime back on my meeting with you at Halifax, I had occasion to mention the discovery of a grave of one of the aborigines of Newfoundland, and also that I had visited the place and had withdrawn several of the relics, which I then described to you from memory, but which I had long before parted with. Since that time I recently met with an old friend, the Rev. M. Blackmore, Rural Dean of Conception Bay, who was the first visitor to the place, and who retains in his possession a number of curiosities collected by himself at the last resting place of the solitary Bœothick, or Red Man of Newfoundland.

"I will now give you his own statement, and in his own words :—'They were found in the year 1847, on one of the Islands forming the Lower Burgeo group, called "Rencontre." This Island is uninhabited, and considerably elevated—difficult also of access in rough weather. It is in a great measure covered with broken fragments of rocks which have fallen from the heights. About half way up the mountain (if I may so term it), and in a hollow formed by a large piece of fallen rock, with every opening carefully closed by small pieces of the broken rock, we, that is I, and the men who had the evening previous discovered the cavity but who would not search into its contents until I came with them, found the bones of a human being wrapped closely round with birch rinds; on removing these rinds a quantity of gravel mixed with red ochre became visible, and on removing this we found the oblong pieces of carved bone, together with the flat circular stones, some glass beads, two iron hatchet heads, so rusty that we could pick them to pieces, a bone spear head, the handle of a knife with part of the blade still in it, also some flints designed for arrow heads—all these articles were together and had been placed apparently under or just before the head of the individual buried—all carefully enclosed in the rinds. The skull was that of a full grown male adult with a very flat crown and large projection behind; the place of interment was singularly wild, high up in a cliff overlooking a little cove facing the open sea, and only acessible on this side in very smooth water. It was discovered by a boy while gathering brushwood. This boy seeing a piece of wood projecting from the rock pulled at it to add it to his store, and so loosened the smaller rocks and found the cavity with its contents. He left the stick being too much frightened to take it home. The head of this stick which was about four inches in diameter was ornamented. There were four fragments of sticks, and they must I imagine, have formed a kind of canopy over the body. These relics certainly do not belong to the tribes of Indians at present sojourning in Newfoundland, for on shewing them to some Mic-Macs they at once gave me to understand that they belonged to one of the aborigines of the

Island, and that the owner must have been a great "witch," the word used by the Indian—who also informed me that by use of these oblong pieces of bone, the man could kill his enemies—their use from this it would appear was not ornament only, but a charm also.'

"Such is the account of my friend the Rev. Martin Blackmore, and as I was the next person to visit the place though some four years later, I must say that his report tallies in every respect with my own observation. The Indian's account also agrees perfectly with what was told me by Indians to whom I shewed some of the bones and arrows that I myself had collected in the same place. The presence of iron weapons is easily accounted for, as since the reign of Henry VII. the shores of Newfoundland have been visited by British seamen in pursuit of the cod-fishery, and collisions occasionally took place between the natives and the crews of the fishing-vessels—the fishermen, though not allowed to form settlements or raise buildings in the colony, except such as were absolutely necessary for the pursuit and curing of the fish, customarily left such things behind them as could not easily be transported at the close of each season, and the natives watching for the departure of the whites, invariably plundered their depots. The disappearance of the Red Indian of Newfoundland is only of recent date, and many persons now living have come into personal contact with members of the race. They are now all extinct, and the last representative of them (Mary March as she was named,) died some 35 or 40 years ago. She had been taken when a child and brought up in her captor's family as a servant, but had escaped at different times to visit the haunts of her departed race. Through the kindness of my friend Mr. Blackmore, I am enabled to send you the accompanying sketches which I have made from his collection. The lance or spear head of jasper is one found by myself.

"As I know you are much interested in the antiquities of North America, I hope the sketches will not be without interest to you. I must remark in conclusion that several of the bones are much decayed. An extra amount of work has interrupted the travelling which I had mapped out for myself, and my principal having been seriously indisposed has kept me almost a close prisoner,

"I remain dear Sir,
"Yours very faithfully
"ELIAS MARETT."

ON NORTH ATLANTIC STORMS.

BY J. L. HURDIS.

MANY years ago, when Redfield and Reid were only beginning their observations on storms, I happened to be a passenger on board a sailing ship, bound in the autumn of the year, from England to British North America. Weary with contending against westerly winds, in mid-Atlantic we were cheered by a fine breeze and promising clouds springing up in the S.E., and speculating on keeping the fair wind for some days at the least, when the skipper, a seaman of experience in those latitudes, chilled our hopes by stating that no reliance could be placed in these easterly winds, which were sure to veer to

to the South and S,W. blowing very hard with rain at the latter point, then "jumping" into the N.W., there ended, leaving you once more to the vexation of a head wind and blue sky—all this, too, it was prophesied, was to happen in the brief space of three or four hours. The skipper was marvellously correct. Several of those minor revolving gales, all alike, passed over us in succession, convincing me that there must be some law of nature regulating these things. After years found me in the Bermudas, a region, I may say of revolving gales, and now I have spent ten years in this country; and when I connect my experience of former years with recent observations, I cannot avoid the conclusion that all the revolving storms of this country, and they are very many, come to us from the tropics of the Western World.

THE following notice occurred in the "*Bermudian Royal Gazette*," of September 12th, 1865.

"Yesterday was the anniversary of the dreadful hurricane with which Bermuda was visited in 1839. The wind on the 11th September, 1839, as on yesterday, was from the Eastward. It subsequently, however, during the continuance of the hurricane, went to E.S.E.—S.—then S.W. and eventually to W. Though the appearance of the sky yesterday was very unsettled, it did not bear any thing approaching the copper coloured hue which it presented on the eventful day above alluded to.

"The hurricane of 1839 commenced at about 7.p.m., and the storm did not subside till about noon on the 12th. The Barometer fell to 28·3, and soon after the storm subsided, it rose to 30·1. The Thermometer ranged from 85-81, and went down to 71 soon after the weather moderated.

"The melancholy appearance of the Island on the 12th from the destruction which the gale had caused, can never be forgotten by those who witnessed it. Scarcely a house escaped injury; some were levelled, others unroofed and side-walks split to the foundation; trees broken and prostrated, and a number of vessels and boats driven on shore.

"A distressing drought of nearly six months' continuance preceded the hurricane."

This Hurricane of the 11th September, 1839, reached Charlottetown, in Prince Edward Island, 46 N. lat., on the 13th September, at 2 p.m, the wind blowing from the N.E., and freshening rapidly.

I was at that time stationed in the Island, and, at the commencement of the gale, watched the two ferry-boats as they crossed the Hillsborough. At 3 p.m., I returned to my own residence on the north side of Charlottetown, the storm then blowing with sufficient force to hurl sundry loosened bricks from the top of one of my chimneys.

This hurricane was, therefore, forty-three hours in traversing the 983 English miles between the Bermudas and Charlottetown; being at the rate of 22·86, or nearly 23 English miles per hour. The time occupied in passing over the Bermudas was seventeen hours, which, measured by the speed above

mentioned, gives a diameter to the storm of 388 English miles, at that particular period of its existence. Reduce this diameter 28 miles in order to be within bounds, and it will then be 360 Eng. miles in breadth. Now, suppose the extreme height of this hurricane from the surface of the earth, to be two such miles, which is probably beyond the reality, and we shall have a whirling mass of atmosphere and cloud, representing a flattened disk, the width of which would be equal to 180 times its own thickness, or, resembling, in diameter and thickness, the proportions of an ordinary dinner plate. This immense circle would cover an area of 101,787 square miles, and would be quite flat if the surface of the earth presented a dead level; but, moving over a rounded or globular form—the segment of a sphere—the under side of the hurricane would necessarily be concave, and the upper surface convex, to correspond.

In this form, I conceive, did the hurricane of 1839 advance from the Bermudas towards the N. and N.E., revolving upon its centre (which centre passed immediately over those islands) from right to left, if viewed from a standing point in the centre; with what velocity we know not, but if estimated at five times the rate of direct progress, it would give 120 miles per hour. During the prevalence of this hurricane in Prince Edward Island, the wind veered from N.E. to S.E. S.W. and N.W., where it terminated sometime before daybreak on the 14th. A few old buildings were levelled to the ground, and sundry trees of thirty years growth blown down, but, with these exceptions, little material damage was sustained. The outer margin of the gale extended to Bay Chaleur, where H.M.S. "Andromache" was then riding at anchor. In that locality, however, it was not severe.

In Keith Johnston's Physical Geography for Schools, it is stated that the West India hurricanes commence near the Leeward Islands, travel to the W.N.W., and then round the shores of the Gulf of Mexico, following the Gulf Stream, and are lost between the Bermudas and Halifax. Other writers terminate such storms south of the Island of St. Pierre, Newfoundland.

The hurricane of September 11th, 1839, took a more easterly course, and was certainly not *lost* in the longitude of Bermuda, or St. Pierre, Miquelon.

It is a remarkable fact that in the ten degrees of latitude north of the equator, in the Atlantic, hurricanes are unknown, and that the same exemption extends to every part of the South Atlantic. It is, then, between the 10th and 20th parallels of north latitude that we must look for the commencement of these storms, so ably described by Mr. Redfield and the late Sir William Reid.

The greater number of the so-called West India hurricanes pass to the north, between the Bermudas and the shores of the United States, sometimes in close proximity with the former, and on other occasions sweeping over the seaboard of those States. The hurricane of September 11th, 1839, passed, however, directly over the Bermudas, eastward of the usual track, and we know that it was not *lost* in the longitude of Halifax, N.S., but continued its course into the Atlantic with fearful violence.

A revolving tropical tempest of this enormous extent, high rate of speed, and power, with a wide ocean before it, free from islands, mountains, and other physical obstructions, must, under the circumstances, continue its onward and

irresistible course for hundreds of miles, and thus be found on the European side of the ocean, without exhibiting any material symptoms of exhaustion. Expansion, and a corresponding loss of speed and power, are, I believe, characteristic of these storms, and for this due allowance must be made, to render it possible for opposing winds to offer resistance to its progress. If a north or south wind of less velocity or power than the revolving gale, comes in contact with it, at this period of its career, such a wind would be compelled to give way; not, however, without infringing upon and disturbing the outer circumference of the hurricane, and causing portions of whirling matter to be separated from it. These minor portions of the cyclone would, I conceive, retain their revolving character, and continue their easterly course, somewhat diverging from that of the present storm.

I think it probable that many of our West India hurricanes are broken up by repeated collisions of this nature, and that, from this cause, arise those minor revolving gales which sweep over the British Isles and the coast of France in rapid succession, during the autumn months of the year.

It is likewise evident to my mind that revolving gales of greater diameter and force than these miniature cyclones, occasionally cross the Atlantic and reach the shores of Europe. The gale in which the unfortunate "Royal Charter" was wrecked on the Welch coast, in October, 1859, may be cited as a case in point. The warm temperature of that gale was alone sufficient to distinguish it from a cold straight blowing easterly wind.

Valuable information regarding these mighty storms might assuredly be found in the log books of ships which constantly cross and recross the Atlantic in the latitudes of their occurrence. The steam packets of the Cunard line, on their outward and homeward voyages must have encountered these gales again and again; must have steamed into them and through them, or gallantly held their course as the storm swept over them in its N. E. course.

Now, in regard to the late storms of December 1865, and Jan. 1866, there is no room for doubt; one and all have shewn the same tropical characteristics; revolving and proceeding in a N.E. direction. As to their destructive tendency, the published accounts sufficiently speak. Was the storm in which the "London" foundered, a revolving one or not?

The "Amalia" sailed from Liverpool on the same day the London left Plymouth, following in her track. The Amalia's published account says the storm set in on the 10th January, at noon, with a fresh breeze from S.W.

4 p.m.	Gale increasing.
6 p.m.	Blowing a hurricane.
8 p.m.	Violent hurricane.
9,45 p.m.	(Barely 10 hours) Engines stopped, and ship unmanageable.
January 11.	Similar weather.
2 a.m.	Deck pumps rigged.
9 a.m.	Set canvas on ship.
3,30 p.m.	Sighted S. Sh. "Laconia."
Midnight.	Squally, and high sea.

All this time the ship was sinking—January 12th, 9 a.m., "Laconia's" boats came alongside, crew saved.

I think it most likely she first encountered the storm from the S. then S.W., and so on. The ship sunk in Lat. 46° 31′ N. and Long. 8° 40′ W.

The Royal Mail Steam Ship "Rhone", Captain R. Woolward, Commander, on her way from Southampton to Lisbon, fell in with the same gale. The Captain says, in a letter to the Secretary of his Company:—"We encountered a severe cyclone on the 11th instant, wind from S.E., veering eastward to north, in which I am sorry to say the two life-boats on the port side, and the cutter were lost, the starboard cutter and mail boat damaged, the rails and deck furniture much injured, two horses killed, and one of the crew had his leg broken. I have never before experienced such a gale. The barometer fell an inch and 11·100 in 12 hours, going as low as 28·34, and although the wind was fair, we were obliged to lie to for ten hours."

This is valuable information, and with that supplied by the crew of the "Amalia," we gain a fair insight into the character of the storm.

Again on the 14th January, the P. & O. Company's Steam Packet "Tanjore," arrived from the Mediterranean, having experienced very heavy weather in the Bay of Biscay, during which "phosphoric balls," as my informant called them, appeared on the extremities of her yard arms. This may, or may not be a characteristic of tropical storms, but whether it be so or not, I mention the fact as one worth recording.

With such evidence before us, I hardly think any one will be disposed to question the revolving character of the late Bay of Biscay storms.

The next consideration is, whether there have been any great tropical storm, or storms, in the centre of the Atlantic, which might be connected with the storms recently experienced on the coast of England and France.

Of this I think there can be little doubt. The "Palinurus," from Liverpool, and the American Ship "Christiana," from London, both bound to New York, found themselves, at half passage involved in a furious hurricane, which crippled the first, and made a complete wreck of the second. Unfortunately, I can obtain no reliable data whereby to fix the locality of this storm upon the map, or to trace it in its progress to England. All my calculations, so far, have failed in any useful result, beyond an impression that the storm was much slower in direct progress than such storms on the western side of the Atlantic.

Thus the Christiana had the storm on the 19th and 20th December—no latitude and longitude given. The Palinurus in longitude 39° 20′—no date stated.

Mariners, in describing the storms that have recently passed over this part of the world, almost invariably allude to the presence of a heavy *cross sea*, as one of the great difficulties they had to contend with.

A gale, blowing in a straight line, will cause the ocean swell to roll in one direction only; and, if two straight gales should meet from opposite points, or at right angles, a cross sea would be the result.

These cross seas are very perplexing if not dangerous. In my December voyage across the Atlantic, the vessel I sailed in, was unfortunately becalmed in a very heavy cross sea, and the awful wildness of the extraordinary scene I shall never forget. Huge waves were rolling in different directions and

coming into collision with each other, the two united sometimes rising to a peak, and representing what our skipper was pleased to term a "church steeple." Great attention was paid to the compass during this commotion of the sea, and the astonishment of the skipper, and of an old sea captain who was a passenger, is still fresh upon my memory; as a mighty wave upon the starboard beam swung the ship half round the compass, and a cross sea, or seas, from the opposite direction, completed the circle, the passenger captain exclaiming, "zounds, why she has gone completely round the compass on her heel, never saw such a thing before in my life." It was not pleasant to be knocked about for two hours in such a cauldron, and I was heartily thankful when a fine fair wind set in and enabled us to extricate the ship from her dangerous position. Cross seas had certainly much to do with the destruction of the London and Amalia, flooding the between decks, quenching the engine fires, and ultimately causing both these overloaded ships to founder.

With regard to the "phosphoric balls," seen on board the "Tanjore," let me observe that the phenomena is by no means a common one, many an old seaman never having seen it. I believe it is called "*St. Elmo's fire*"—"*Corpus sanctum*,"—and a variety of names which appear to be corruptions of the latter. I am happy to say I once witnessed this concentration of the electricity of the atmosphere upon the rigging of a ship. It was on the same December voyage from Prince Edward Island, our little brig, the "Eliza," not quite two hundred tons register, was making her *debut* upon the ocean, and had been scudding before a severe gale during the eight hours of daylight which we enjoyed at that late season of the year. The darkness of night had come upon us, but with two good men at the wheel, and our skipper, a superb seaman, conning the ship and steering by the stars, all proceeded well. Wearied in body by watching the progress of the storm all day, I seated myself upon the cabin floor, in front of a bright fire in the stove, placing one arm round the leg of the cabin table to secure my position, and here I was rocked to and fro to the hoarse music of the winds and waves, until half asleep, when a seaman entered to say the captain wanted me on deck immediately. The mandate was instantly obeyed. Pointing to the main-top-gallant-mast head, the captain called my attention to a bright light upon the copper vane spindle. It was like a brilliant star in the dark heavens, and was mistaken for one by the skipper before sending for me; a heavy lurch bearing the light with it convinced him of his error. This light, during my presence on deck, was brilliant for a full minute or perhaps longer, when it disappeared altogether.

Some weeks later I happened to mention this circumstance to a relation residing at Abbeville, in France, when he related to me, as a singular coincidenee, that two French gentlemen of his acquaintance, had recently travelled together, on horseback, from Amiens, and night having overtaken them upon the open plains, they were quietly proceeding along the road, in conversation with each other, when one of them exclaimed with surprise, "do you see that light upon my horse's ears!" Hardly had the observation been made than the light also appeared upon the eartips of his companion's horse.

St. Elmo's fire, old mariners affirm, usually appears on the extremities of

the lower yard arms, first, then removes to the top-sail yards, and so on till it reaches the mast head. An old officer of the *ci-devant* East India Company, tells me, that on one of his voyages the look-out man proclaimed, "a light ahead," and on some officers proceeding to ascertain whence it emanated, they were astonished to find this electric light in possession of both ends of the spritsail yard.

Reverting to the subject of Atlantic revolving storms, let me add in conclusion, that I consider their usual course, indeed their never varying course, is from the West Indies northwards between the Bermudas and the North American coast to latitude 30, where they head to the north-east, and passing Nova Scotia and Newfoundland, rush onwards towards Europe. Bermuda thus represents a sort of turning point, round which these storms describe their course, but at such a distance as most frequently to avoid coming into collision with the spot. Exceptions of course take place, especially in the winter season, when Bermuda gets a full share of these revolving gales. Now, from Nova Scotia to the meridian of 30 west, these gales must have prevailed during December and January, for in that longitude their violence was something terrible to contemplate—witness the wreck of the "Christiana," the "Jane Lowden," and a host of other ships, all crumpled up in the open sea, in a manner truly marvellous. These storms were *moving* to the north-east, and most assuredly did not *commence* their motion in that longitude, but far away in the tropics; generated by that great motive power, *heat*, the source of all motion, if I mistake not. Well, from longitude 30 to our own shores, the track of these storms is only too distinctly marked out by the dismal amount of ships and cargoes that have been strewed in fragments upon the surface of the sea, and to which brave men have too often clung in the vain attempt of saving their lives. The rest we know and will pass over for the present.

Bear in mind that in the Indian Ocean, north of the equator, where no cold Arctic current is known, its revolving storms move in the same direction, turn in the same latitude, and obey the same laws as those of the Atlantic. Also, that none but straight winds belong to the temperate regions of the earth; that the coast of Africa lies almost entirely within the tropics, where trade winds always prevail; and that whenever a revolving storm appears in the north, we may safely set it down as a tropical wanderer. I cannot for a moment entertain the idea that revolving storms can be generated to the north of the tropics.

Fourteen years of isolation in the Bermudas made me somewhat familiar with the winds of the Atlantic, and I can confidently assert that no hurricane or revolving gale, great or small, ever came upon us there except from the south or south-west. Taking all these circumstances into consideration, could we otherwise conclude than that the revolving storms which annually speed on their destructive course over the wide waters of the North Atlantic, originate in the region of the tropics.

FIELD MEETING AT ASHBOURNE, JUNE 26, 1866.

By invitation of the President, a Field Meeting of the Institute was held at his residence at Ashbourne, North West Arm, and vicinity, on Tuesday the 26th June.

The programme contemplated,—1. a visit to Downs' Zoological collection, head of the North West Arm, and thence to Ashbourne. 2. A visit to the grave of the late Titus Smith, eminent in Nova Scotia as a Naturalist, where the President would read a short sketch of the life of that person; thence to proceed to Geizer's hill, where a splendid panorama of the surrounding country is presented, and where the party could study the botany and geology of the district. 3. An excursion from Geizer's hill to Byers' lake. 4. The return to Ashbourne to dine, and afterwards to visit the President's private museum.

The party assembled at the Province building, where conveyances were in waiting to take them to Downs' cottage. The day was beautifully fine but intensely hot, the thermometer ranging 84° Fah. On arriving they were received with a hearty welcome from Mr. Downs, who very politely escorted them over his grounds, and showed them all the curiosities. Amongst these the principal and more imposing are a splendid young polar bear, a seal, and several deer and antelopes from southern America. The collection consists otherwise of foreign, British and native animals, birds and beasts, of rare and interesting species, all well worthy the inspection of naturalists, and of strangers visiting Halifax. After passing an hour delightfully, the party next proceeded to Ashbourne, the mansion of the President, where they were hospitably entertained, and rested for a while previously to entering upon the further business of the day.

Ashbourne is prettily situated, at an easy distance from the city, and just beyond its taxation, an advantage not to be despised even by men of science. The grounds are tastefully cultivated, and on either side, within a neighbourly distance, are neat suburban residences, and progressive improvements, which at no distant day will make the "Dutch Village," so called, one of the most delightful spots in Nova Scotia. The scenery embraces northward, a view of Bedford basin, bounded by the sombre pine-clad hills; eastward, the well cultivated fields and farm houses of the peninsula, and beyond, the citadel and the upper portion of the city of Halifax; southward is the North West Arm, the harbour of Halifax, and a grand ocean distanee. The soil, which is susceptible of the highest cultivation, rests on the metamorphosed slate of the peninsula, and here and there on the surface are scattered granite boulders, large and small, derived from the glacial action of which the district has largely partaken. There can be little doubt that here as elsewhere in the metamorphic coast band, gold is present in the numerous quartz veins that make their appearance wherever the rock is exposed. Westward, and at a short distance, are the chain of lakes which help to furnish the city with a copious supply of water. These, as well as the valley of the Dutch village, have evidently

been scooped by glaciers, which have also formed the North West Arm, and largely denuded the rocks and excavated the depths along the western shore of the harbour.

From Ashbourne a walk of half a mile through the forest led to the Naturalist's grave. It is a quiet spot on a rising ground in view of the surrounding landscape, covered with a young growth of birch and other deciduous trees—just such a place as a philosopher might be expected to select for his last repose. Here all around "the rude forefathers of the hamlet sleep,"—the Dutch and German emigrants, who more than a century ago, settled at this place, which was called after their name. A wooden railing, fast going to decay, marks the grave of the "Philosopher of the Dutch village." The party encircled it, and with bared heads listened to the interesting recital by the President, of the biography with which he had been furnished. At its close, anecdotes and reminiscences of the departed were conjured out of the past, and related by those who had known him and admired his talents and unobtrusive virtues. It would be an act of grace, while the remembrance of the man lingers among the present generation, to erect a more befitting monument to one who may be truly regarded as a pioneer of civilization and science in Nova Scotia.

This tribute rendered to departed worth, the journey was made to the top of Geizer's hill, the highest ground in the vicinity, from which there is an extended view of the country that amply compensates the fatigue of the ascent. Geizer's hill is nearly of the same elevation as that on which the citadel stands, and which it pretty well commands. It is composed of metamorphosed slate and quartzite, much disturbed, with granite boulders interspersed—the compactness of the rock, and probably its elevation, preventing the erosion which has evidently befallen the land for some distance on either side. The retreat of the glaciers however, must have left a considerable deposit of clay and drift, and this impregnated in the lapse of time with granitic and slaty detritus and decomposed vegetation, has in some places produced a fertile soil, which at this height appears to reward the labour of its cultivators.

The land at a short distance from the hill inclines with a gradual descent to the chain of lakes which skirt the Margaret's bay road. Byers' lake, the next requirement of the programme, is about a mile distant in a north-westerly direction. Just however as it came in sight, after a hard scramble through bushes and over interminable boulders, it became the unanimous opinion,—taking into consideration the intense heat, and the exertion required to overcome the difficulty of the way, and the little of interest that might be expected when the goal was reached,—that it would be wise to retrace the route. The main body accordingly returned to Ashbourne, where they were soon after joined by stragglers who had taken another direction, but eventually had arrived at a similar conclusion. The extreme heat and toil had told more or less upon all, but all were in excellent humour, and in half an hour were well prepared, with sharpened appetites, to discuss the ample repast prepared by their worthy entertainer.

An excellent dinner was served under the trees, in a hardwood grove a

little distance from the mansion. Mr. Parish the photographer was on the ground, and attempted a sketch of the scene, but owing to the broken light among the trees, was but partially successful. A pleasant hour quickly passed, after which a visit was paid to the PRESIDENT'S private museum, which is contained in a building erected for that purpose.

The collection of specimens gathered together in this building is varied and interesting, comprising many rare and curious forms in every branch of zoology, brought at much trouble and expense from various parts of the globe, and exhibited either in the drawers of cabinets, or in table cases which extends down the centre of the room. The foreign entomological collection, principally from the East Indies and South America; the conchological collection containing some rare land shells from New Guinea, Arroo and other Pacific islands; and especially the beautiful specimens of corals from the Bermudas—attracted the notice of the members. But perhaps the most interesting portion of the whole lay in the series of madrepore and asteroid corals, illustrating the growth of the Bermuda reefs, which is considered by Mr. Jones to be far more rapid than is generally supposed. Coal, glass bottles, recent shells, containing their inhabitants; roots of trees, &c., were here to be seen coated with a vigorous growth of coral, affording facts sufficient to prove beyond a doubt that some polyps are able to secrete their calcareous forms very rapidly in the Bermuda waters, in comparison with similar or allied species in other parts of the world, which according to some naturalists are *supposed* to take thousands of years to form a few feet of calcareous matter. The collection of Nova Scotian reptiles was also worthy of notice, as it possessed nearly every species known to the country, and in some cases species were exhibited in all stages, from the embryo to the adult. The whole collection comprises from seven to eight thousand specimens.

This ended the first Field Day of the Nova Scotian Institute, for 1866. A subsequent half hour was spent on the green sward amid the quiet beauties of nature and in merry social converse, under the influence of a delightful summer evening. Carriages then arrived to take back to the city the Members and their friends—and the party broke up, after kind adieus to the worthy PRESIDENT, by whom they had been so agreeably entertained.

W.G.

SOME ACCOUNT OF THE LIFE OF TITUS SMITH. BY WILLIAM SMITH.
(COMMUNICATED BY THE PRESIDENT.)

AT a Field Meeting of the Institute held at Ashbourne, near Halifax, the residence of the PRESIDENT, June 26, 1866, one of the places of interest visited was the grave of TITUS SMITH. Mr. SMITH resided at the commencement of the present century for several years in the vicinity of Halifax, leading a retired life and devoting nearly his whole time to the study of nature. He was one of the first observers who paid attention to the Natural History of Nova Scotia, and his manuscript notes contained in the archives of the Province, bear testimony to the careful manner in which he registered all facts, especially those relating to the botany of the country. Being employed in different Provincial surveys in the interior he had ample opportunity of pursuing his favourite study, and made such good use of his time while in the forest on these expeditions, that he was enabled to write a

concise history in manuscript of Nova Scotian Forest Trees, and Shrubs, which contains much valuable information. He retained a vigorous intellect even to extreme age and by a kindly disposition manifested to those around him gained the good will of all. He died at his residence in the Dutch Village, a small-farm house on the borders of the forest, which had been for many years his home, and according to his wish was buried in a picturesque spot in the pine woods overlooking the calm waters of Bedford Basin.

The following letter was written by his brother, resident in the United States, in answer to enquiries made respecting his early life:—

"WATERTOWN, JEFFERSON COUNTY,
March 10, 1850.

"*Dear Sir*,

"Yours of the 4th ult., came duly to hand, in which you inform me that the friends of my late brother are making arrangements to publish his *writings*, and ask me for such facts as memory can furnish relative to his parentage, the character and standing of his father, his motives for leaving the United States and adopting Nova Scotia as his final residence, and his position during the American Revolution. Also, indications of character, and predominating attachment to particular branches of science manifested by my brother in early life; also for his correspondence with me. The latter has been wholly of a very domestic character, and very few of his letters remain in my possession, having been transmitted to a sister of his and mine, residing at a distance, and who now like him is numbered with the dead. On the general subject of your enquiry, the information must necessarily be limited, about fifty-four years having passed away since I last saw my brother; but such information as I have here to give, obtained from my father and some of his early friends, added to what memory can supply on the subject of your enquiry, will be most cheerfully communicated, Indeed it is a source of gratification that the gentlemen you name, should give so distinguished a mark of consideration to the memory of one so very dear to me, the constant companion of my childhood, and to whom I feel indebted, for the early inculcation of the principle 'that knowledge is better than fine gold.'

"I shall speak in the first person in naming recollections of our ancestors, who at an early day emigrated from England and settled on the Connecticut River, in South Hadley, county of Hampshire, and now state of Massachusetts. The first of whom I have any knowledge, was my grandfather, generally known as Deacon John Smith, who was born about the year 1690, and was by occupation a farmer. During much of his life theological considerations engrossed almost the entire public mind. The settlements too were surrounded with tribes of hostile Indians, so that procuring the necessaries and comforts of life, and guarding the frontier against the inroads of the savages, left little time for literary pursuits. Neither have I any knowledge of his tastes. He held the rank of a captain in the Frontier Guards, and occupied for most of his life the position of Select-man; (three officers bearing that title being elected by the inhabitants of the town, to whose hands was committed the public concerns of the town); he was considered a man of strong common sense. My father who was his fourth son, was born June 4, 1734. Of his early history I know but little. His constitution was not strong, and having an ardent desire to study, he fitted for college; but the war with France of 1756 coming on, and the French having brought many of the Indian tribes into their interest, the utmost vigilance was required to protect the inhabitants of the frontier. My

father on that occasion was a volunteer. After that danger subsided he entered Yale College, and I think in 1765, having given much of his mind to theology, he went after leaving college as a missionary, and spent I think, two or more years with the Six Nation Indians, now Central New York. On his return in 1768 he married a Miss Nash, to whom he had been engaged seven years. My brother Titus was the first child by this marriage; he was born in 1769. After my father's return from the Indian country he followed preaching for a time as an itinerant, often in the open field, and to audiences of many thousands. Finding his health giving way, yet thinking he might attend to the duties necessary in a small parish, he settled in West Suffield in Connecticut, but was soon driven from the pulpit by bleeding at the lungs and a diseased liver. On retiring from this field of labour he commenced the study of medicine, which he pursued with all the energy that his low state of health would permit. About this time his attention was attracted by a theological treatise written by Dr. Glass, of Scotland, and also a work entitled "Theron and Aspasio," written by Mr. Robert Sandeman. His mind was forcibly struck by what he deemed the unanswerable truth contained in these works. He opened a correspondence with Mr. Sandeman, which resulted in the removal of that gentleman to America. A church was soon after formed at Dunbury in Connecticut, called a Sandemanian Church, to which place my father removed. Mr. Sandeman after forming several churches finally died at my father's house in Dunbury. My father had fully imbibed the theological opinions of Mr. Sandeman, and had accepted an appointment of a presiding elder over one of these churches. This religious sect was remarkable for putting literal constructions on the bible. Although my father entered deeply into the feelings that produced that revolution that resulted in a separation of the colonies from the mother country, yet believing as he did that duty required him to render obedience to existing powers as being ordained by God, he declined taking an active part in the revolution, and sought for and obtained leave from Congress to remain neutral, on his word of honour to do no act to aid or assist the enemies of his country; but nothing is more vividly impressed on my mind than the great energy with which I have heard him undertake to foretell that the American Revolution would under Providence raise up a people and nation that would afford a refuge for the oppressed and distressed of every nation; that by the disconnection of church and state religion would be left free, and the volition of the mind being untrammelled would open a new era in the world. About the year 1779 my mother died leaving four living children, of whom I was the youngest having been born in Feb., 1777. In 1785 my father was called by a church formed at Halifax to preside over them as an elder. He located himself on a farm in Preston. In the month of Oct. 1795, I left home for the United States, and have not since visited that country. My brother Titus became an early reader under the teaching of his father. At four years old he read English books with facility. He had at a very early age the advantage of a good private school kept by a Mr. Daniel Humphrey, a graduate of Yale College. At seven he had made considerable proficiency in Latin, and at twelve could translate the most difficult Latin authors, and had also made good progress in the Greek.

"In early youth he evinced no desire to mingle in the amusements of children, but always sought the society of those from whom he could derive knowledge. His earliest desires appeared to be to perfect himself in a knowledge of languages, Latin, Greek, German, and French. He was more attached to biographical history than any other reading.

"As it was the constant practice in my father's family that one should read and the rest hear,—when the book was in a foreign language, it fell to his lot always to be the reader. Often have I listened with pleasure to hear him read the Commentaries of Cæsar from the Latin text, which he did with great facility. He became early attached to mathematics and astronomy, in which he had early made some proficiency, owing perhaps to a constant cause always operating with him—that was an entire absence of desire to engage the mind in the ordinary amusements that too often draw the mind from the matter in hand. I think it may with literal truth be said of him, that from two years of age he was never known to cry and seldom to laugh. I never saw him angry, and seldom much elated. With an even temperament he pursued whatever he undertook until it was accomplished. About the year 1790 or 1791 my father was furnished by Governor Wentworth with a complete set of the botanical works of Linnæus.

"From this time until I left home, much of the flowering season of the year was devoted to botanical studies, of which his father also was passionately fond

"From that period onwards for more than half a century I have no personal knowledge of his progress; but what may not the mind of man accomplish when the key to knowledge is obtained and the storehouse unlocked, and nature's works are placed in view of an eye that is not diverted or drawn aside by the countless trifles that beset us on every side. Titus had in early childhood lived a few years in the City of Newhaven; while in that city the most of those who visited his father's house were men of letters, and disputations on religious subjects were common.

"From this place his father removed to Long Island on the Sound, nearly opposite the city of New York, and soon after into the city. You enquire as to scenery, and the habits of those with whom his early life was passed. There is nothing remarkable in the surrounding scenery of either of the places of his early residence, neither was he made for a painter or poet.

"Matters of fact—things of real life, and not of imaginary, claimed the greatest share of his attention.

"He was always liberal, setting no very great value on wealth, except so much as was necessary to supply the ordinary wants of life. He thought but little of high birth or titles of honour; I think he only valued men by their knowledge and goodness. I regret that it is not in my power to give you more information, and you will also perceive that much that I have written is from imperfect memory. Only my dates may be wrong, but the story is near the truth. Should anything else occur to you in which I can render service, you have but to make your wishes known. Be pleased to present my kind regards to the family.

"I am, Sir, very respectfully,

"your obedient servant,

"William Smith."

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

PATRON—His Excellency the LIEUTENANT GOVERNOR.

COUNCIL, 1866.

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

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