Proceedings and Transactions

OF THE

NOVA SCOTIAN

INSTITUTE OF NATURAL SCIENCE,

FOR

1867, 1868, 1869, 1870.

VOLUME II.

HALIFAX, NOVA SCOTIA:
WILLIAM GOSSIP, 87 GRANVILLE STREET.
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1870.

ERRATA.

In the Index to Vol. I.—In the plural terminations, read æ for œ.
Page 83, for Art. VII. read Art. VIII.
Page 93, for Art. VIII. read Art. IX

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 f r 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 *Tœnia.*

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 herausgegeben 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.
1863.	Mar.	11.	How, Henry, D. C. L., *Professor of Chemistry and Natural History*, King's College, Windsor.
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 $24\frac{3}{8}$ 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 everywhere, 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 perceptible. 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 feelings 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 primitive 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 $103\frac{3}{4}$° 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 consider 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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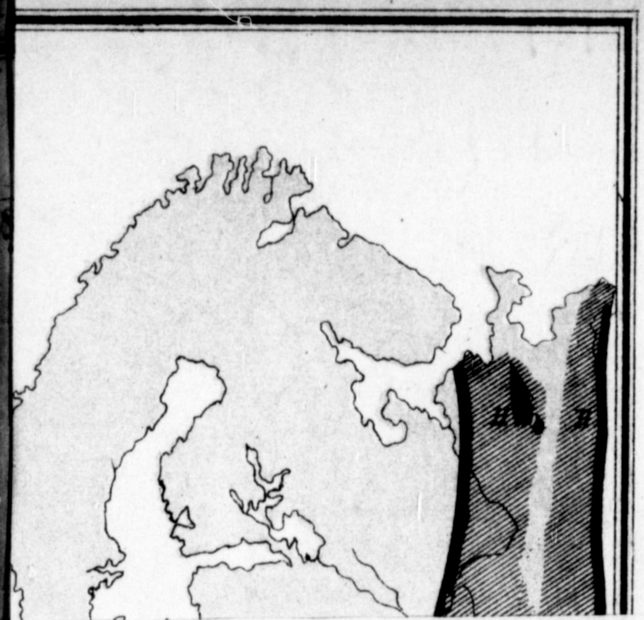
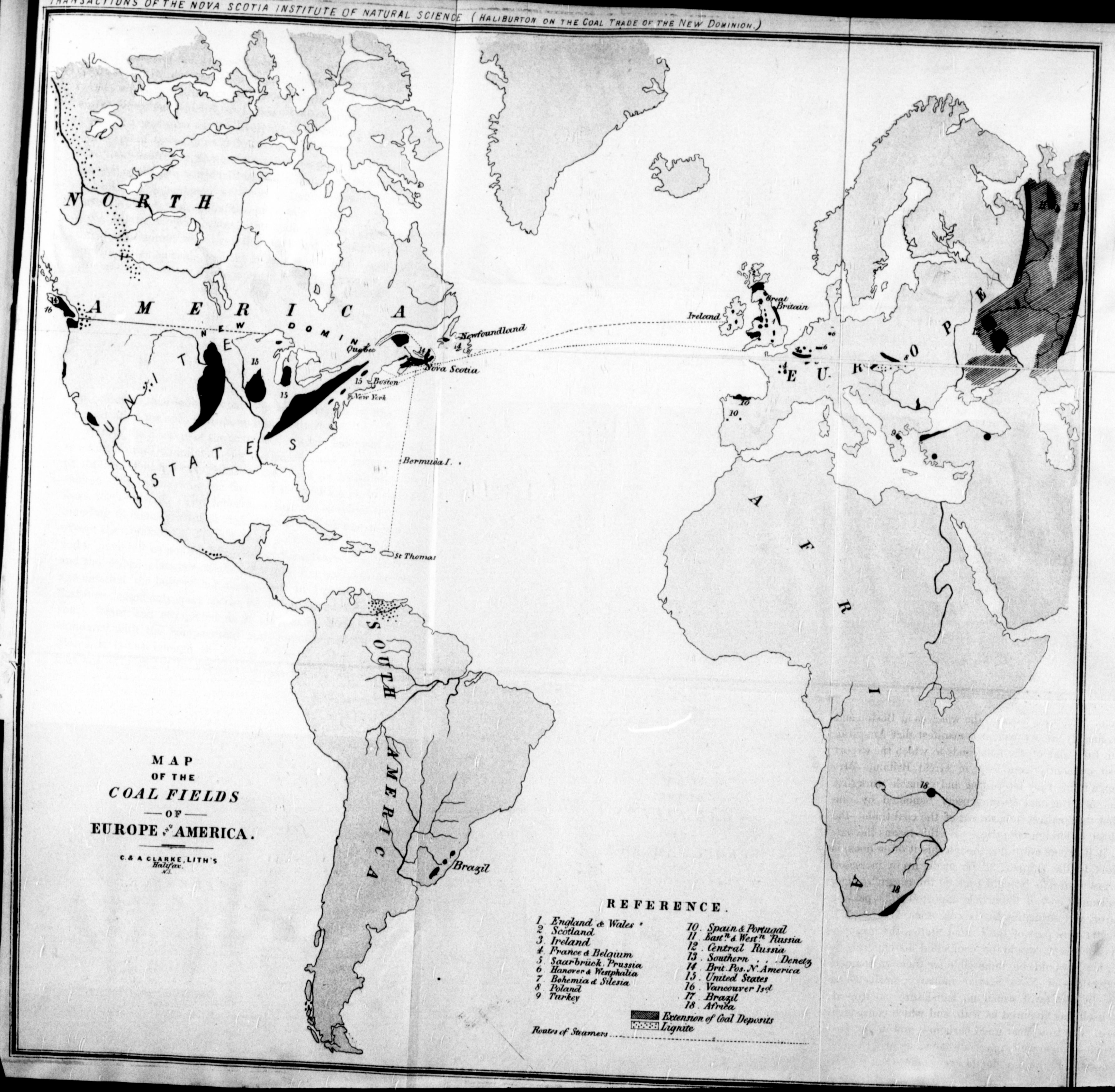


they are only united by national feeling, and by the bonds of


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

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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 collieries 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

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

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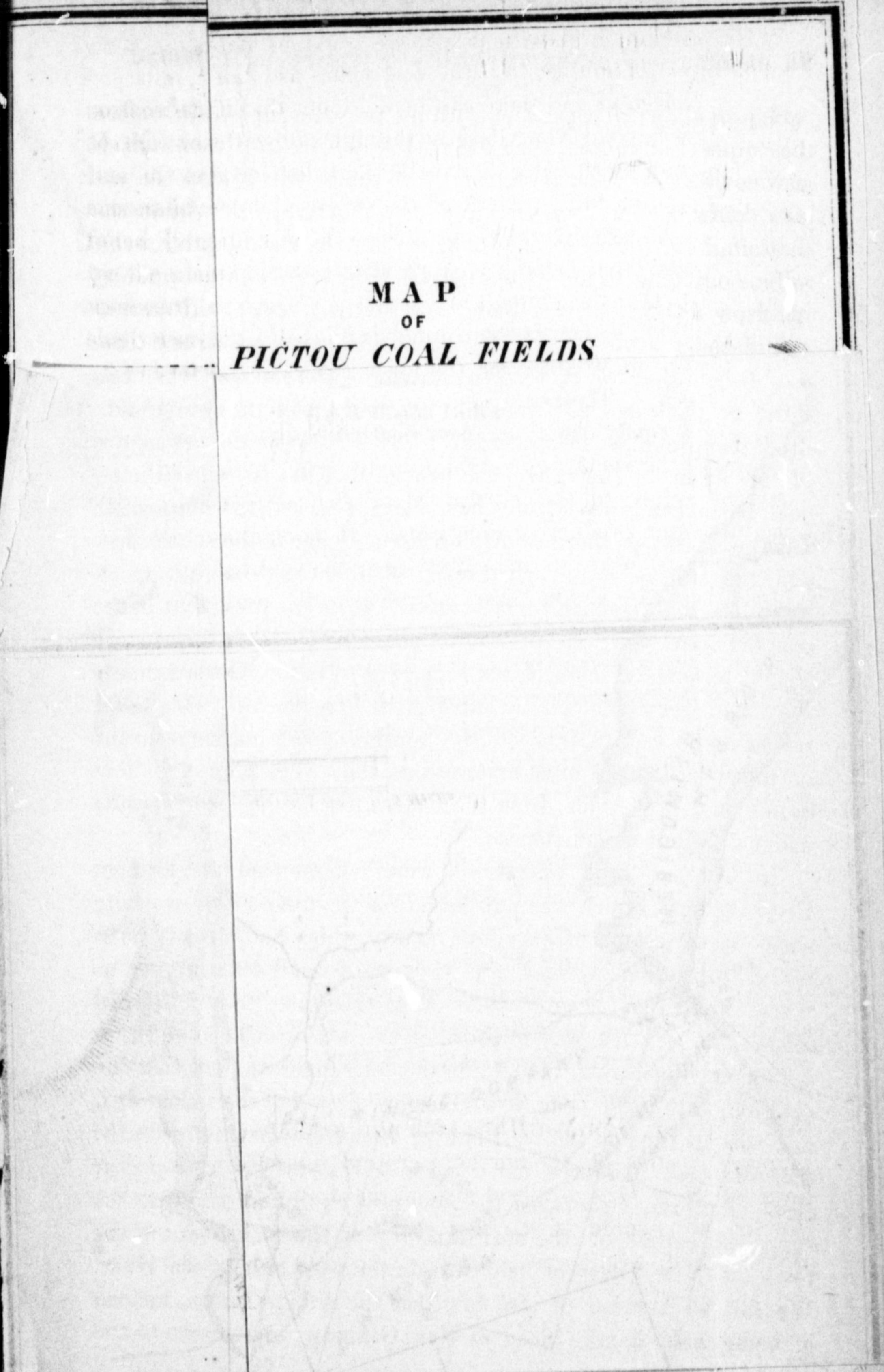

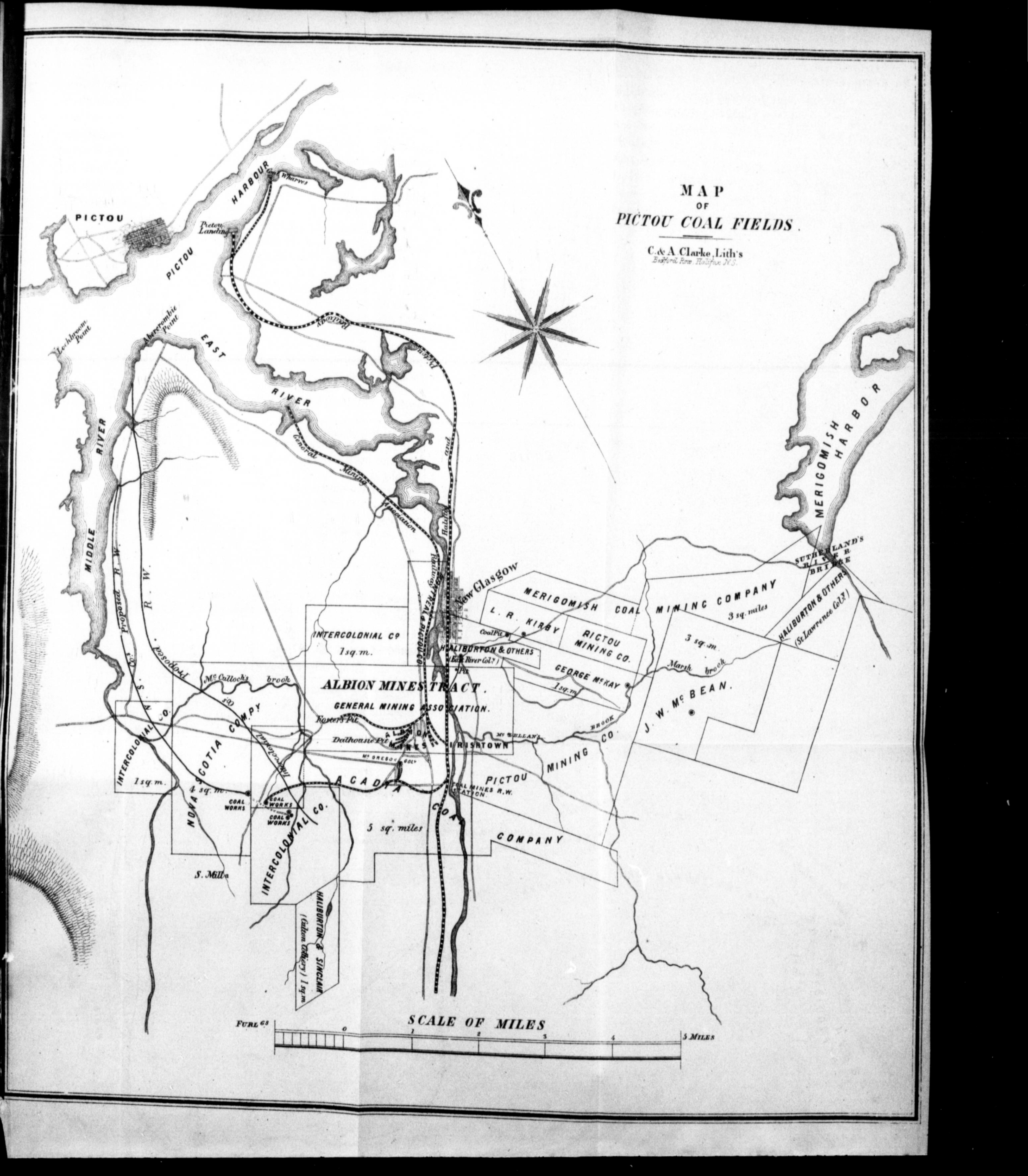
MAP OF PICTOU COAL FIELDS.
C. & A. Clarke, Lith's
PICTOU
PICTOU HARBOUR
Pictou Landing
EAST RIVER
MIDDLE RIVER
Abercrombie Point
MERIGOMISH HARBOR
SUTHERLAND'S RIVER BRIDGE
New Glasgow
MERIGOMISH COAL MINING COMPANY
3 sq. miles
L. R. KIRBY
PICTOU MINING CO.
HALIBURTON & OTHERS
(St Lawrence Col.y)
GEORGE McKAY
1 sq. m.
J. W. McBEAN.
INTERCOLONIAL Co
1 sq. m.
ALBION MINES TRACT.
GENERAL MINING ASSOCIATION.
Foster's Pit
Dalhousie Pit
IRISHTOWN
McCulloch's brook
Marsh brook
NOVA SCOTIA COMPY
4 sq. m.
INTERCOLONIAL CO.
ACADIA COAL COMPANY
5 sq. miles
PICTOU MINING CO.
COAL WORKS
S. Mill
HALIBURTON & SINCLAIR
1 sq. m.
Proposed R.W.
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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 outcrop, 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 r iver, 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.) } THE HADDOCK.
Melanogrammus Œglefinus, (Gill.)

Gadus Virens, (Lin., Gunther.)
Gadus Carbonarius, (Richardson.)
Merlangus Carbonarius, (DeKay, Storer.) } THE POLLACK.
**Pollachius Carbonarius*, (Gill.)

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 *Gadidœ*. 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 into 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 *cœca*, 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 threc 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 communication. 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. Thermometer.	1863. Barometer.	1864. Thermometer.	1864. Barometer.	1865. Thermometer.	1865. Barometer.	1866. Thermometer.	1866. Barometer.	MEANS OF 4 YEARS. Thermometer.	MEANS OF 4 YEARS. Barometer.
WINTER.										
Mean...........	*26°	*29·70	25°	29·71	24°	29·58	23°	29 66	24°	29·66
Range...........	*62	*1·60	54	1·33	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.

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.

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. GUNTHER, 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 *Mæandrina* 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" (*Mæandrina 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 southwest 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 net-work 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 gorgoniæ 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. 17$\frac{1}{4}$

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 fi om 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 produced, 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 silicoborocalcite* 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 magnets 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 French 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 successful, 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

ETON, 60

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

DE 62° 4

....

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

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

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 †60 ft. 060 –F. of Vap.	Highest.	Lowest.	Thermometer. Mean night.	Mean Noon.	Mean.	Coldest.	Hottest.	Relative Humidity.	Force of Vapour Millimetric.	Degrees of Frost below 32.	Nights of Frost.	Below Zero.	Rain. Days.	Rain. Inches.	Snow. Days.	Snow. Inches.
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
February	29·884	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	10½
March	29·903	29·849	30·527	28·791	17·1	29·5	23·3	-2	44	73·1	2·90	465	30	1	11	5·965	9	16½
April	29·806	29·704	30·299	29·092	26·9	40·3	33·6	19	57	75·3	4·13	129	27	.	15	5·085	9	15¼
May	29·867	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
June	29·969	29·726	30·322	29·590	47·2	60·8	54·0	32	78	58·6	7·716	..	1	.	12	2·010	"	"
July	29·834	29·477	30·283	29·376	53·5	66·7	60·1	43	80	71·7	10·578	..	.	.	13	3·080	"	"
August	29·950	29·481	30·322	29·644	58·6	74·7	66·6	45	85	65·3	13·454	..	.	.	7	2·560	"	"
September	29·954	29·653	30·289	28 676	49·9	62·3	56·1	36	75	72·6	9·697	..	.	.	11	11·265	"	"
October	29·918	29·736	30 500	29·150	39·0	50·0	44·5	28	63	73·0	6·001	12	7	.	11	2·920	1	"
November	29·812	29·671	30·279	29·064	31·5	40·6	36·0	15	59	79·4	5·095	125	14	.	16	4·780	3	9¾
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
Extreme			30·768	28·676				-10	85		In. 2438	2171	172	7	147	58·090	52	Ft. in.
Mean	29·8524	29·6704			34 17	45·95	40·06			72·87	6·194							9·3½

1867.	Wind total Revolutions.	Miles per hour anemometer.	Extreme pounds pr. foot square.	Least Revolutions in 12 hs pr. anemometer.	Greatest Revolutions in 12 hrs. per anemometer.	Halos. Sun.	Halos. 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.	E. to S.
January	758644	20·4	44	606	32782	..	..	..	..	2	2	2	..	..	8	12	5	6
February	802678	23·6	20	4260	26052	1	..	..	..	..	1	..	1	..	8	14	4	2
March	659698	17·7	9	1088	23594	2	..	3	..	..	3	1	..	..	3	12	8	8
April	615098	17·0	12	924	23570	2	..	1	1	2	2	2	2	..	7	9	3	11
May	629463	16·9	7	457	27299	2	..	3	..	3	5	2	..	1	6	10	6	9
June	619496	17·2	14	940	22575	2	..	1	1	2	3	1	..	..	11	10	7	2
July	540656	14·5	3	2174	15960	1	..	..	3	4	5	2	..	..	11	8	6	6
August	535202	14·4	40	1262	21954	1	..	7	..	4	5	..	..	..	15	5	1	10
September	592640	16·4	7	626	22200	2	..	9	2	3	5	1	..	2	12	8	4	6
October	665252	17·8	10	600	22615	2	2	1	1	1	3	2	..	3	11	11	4	5
November	613918	17·0	9	277	33110	1	..	1	..	3	1	..	..	..	14	10	2	4
December	689670	18·5	12	2564	34740	..	1	..	1	1	1	4	2	..	16	5	4	6
Extreme	7722414	17·6	44	277	34740	16	3	26	9	25	36	17	5	6	122	114	54	75
Mean	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	50.91	41·97	-22	98	...	....	2470	189	19	173	44·967	63	Ft. in. 10·5

10 years	....	..	..	...	....	..	..	..	19	..	..	..	..	..	112	126	66	61

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

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

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 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 windguage, 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	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.
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	

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), } Hoary Bat.

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 historic 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 become 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). } **Raccoon.**
Ursus Lotor (Linn, Erxleben). }

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-

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* 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 excessively 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 froze 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, *cœteris 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 contained 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 certainly 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 distribnted over the North American continent. It has been traced as far north as the State ot 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 whieh 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 dilatea 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 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 journey to the ocean.—They have certainly no separate, distinct, or specific character; and the barometer heralds their approach like other winds.

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PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. II. PART III.

Anniversary Meeting.

In accordance with the Bye-Laws of this Institute, the Anniversary Meeting was held on Wednesday, October 14, 1868, 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. DeWolf, M. D.

Treasurer—W. C. Silver.

Hon. Secretary—W. Gossip.

Council—P. S. Hamilton, Jos. Bell, Capt. King, R. A., J. Rutherford, Captain L'Estrange, R. A, T. F. Knight, Dr. A. C. Cogswell, F. Allison.

Ordinary Meeting, November 9, 1868.

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

Dr. J. B. Gilpin read a paper "*On Nova Scotian Mammals,*" describing the Black Bear (*Ursus Americanus,*) Red Squirrel (*Sciurus Hudsonius,*) Ground Squirrel (*Tamias striata,*) Flying Squirrel (*Pteromys sabrinus*) and others. The paper was illustrated by drawings of each species. *(See Transactions.)*

Mr. George Piers observed that the Red Squirrel although abundant some years, was scarce in others, and he attributed this to a migratory habit of the species.

The President stated that some few years ago as some spruce trees were being felled near his house, the nest of a Flying Squirrel was shaken to the ground, with young ones in it. It was merely placed like the nest of the Red Squirrel, in the angle of the branch against the trunk.

Mr. Piers said it was not unusual for the Red Squirrel to take possession of the nests of the Flying Squirrel, instead of making a nest of its own.

The President read a note "*On a gigantic Squid (ommastrephes) taken at Cape Sable.*" (See Appendix.)

Col. L'Estrange, R. A., alluding to the habits of the cephalopods, stated that while bathing some years ago in a river on the Coast of Africa, he was attacked by a large Octopus, and only escaped by the merest chance, for as it was, he had the whole of his chest torn as with a saw, and lost much blood.

A fine specimen of the Carolina Dove *(Columba Carolinensis)* shot by Capt. L'Estrange, R. A. near this City, was exhibited; and the Secretary brought to the notice of the meeting a species of sponge which had been forwarded to him by the Rev. W. LeGallais, from Burnt Island, Newfoundland.

ORDINARY MEETING, DECEMBER 14, 1868.

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

Mr. R. G. HALIBURTON, F. S. A. read a paper *"On the Geology of the Pictou Coal Field."* (See Transactions.)

Capt. L'ESTRANGE, R. A. exhibited the head of a cottoid fish, which he had found hanging upon a tree, near Birch Cove Lakes.

In closing the proceedings of the evening, the President congratulated the members upon the present appearance of the Institute Room, which had been recently re-arranged, and the gas and stove fittings placed in more convenient situations. A series of glazed table cases had also been added, in which the typical specimens illustrating the papers of members could be placed, thus forming the commencement of what he hoped would in a few years, form into a well proportioned Museum.

Member elected.—Alderman SINCLAIR.

ORDINARY MEETING, JANUARY 18, 1869.

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

Mr. RUTHERFORD read a paper *"On a peculiarity in the Blockhouse Coal Seam, at Cow Bay, Cape Breton."* (See Transactions.) Carefully prepared diagrams, shewing the nature of the overlying deposits illustrated the paper.

Mr. FOORD read a paper *"On Gems and their application to the Arts."* (See Transactions.)

During the discussion which followed the reading of this paper, it was stated that a diamond had been found some years ago in King's Co., N. S., which on being forwarded to New York, sold for $160.

ORDINARY MEETING, FEBRUARY 8, 1869.

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

The Secretary (Mr. W. GOSSIP) read a paper *"On the Antiquity of Man in America."* (See Transactions.)

The President read a paper by the Rev. C. J. S. BETHUNE, of Credit, Ontario (Secretary of the Entomological Society of Canada,) *"On Nova Scotian Lepidoptera."*—(See Transactions.)

The paper was the result of an examination of a collection forwarded to the author by the President. One species of *Anarta* was new to the Canadian fauna, and Mr. BETHUNE proposed for its specific name *Acadiensis.*

Associate Member elected.—Mr. ANGUS ROSS, of Goldenville, Guysboro'.

ORDINARY MEETING, MARCH 8, 1869.

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

The President read a letter from HENRY POOLE, Esq., of the Caledonia Coal Mines, Little Glace Bay, Cape Breton, which included a diary kept by him while at the Albion Mines, Pictou. It described the circumstances which attended the finding on the 17th March, 1860, of a piece of wood 3½ feet below the surface of the ground, while the men were engaged in cutting a drain at Fraser Mine, Pictou. This piece of wood, three feet long, showed marks of having been cut by an axe; while the trees growing above the spot were two feet in diameter; and he had counted 230 rings of annual growth in the hemlock tree cut down just over the chopped piece of wood. On this occurrence Mr. POOLE propounded the following queries:—Who could have been cutting wood two and a half centuries ago, so far from the Harbour? Was Pictou harbour known to Europeans at that time? or, Were the Indians at that time acquainted with and using iron axes?

The Secretary in reference to the first query, stated that DeMonts and Poutrincourt arrived in Nova Scotia, in the spring of 1604, and Les Carbot in 1606, and made a Settlement at Port Royal, (Annapolis.) At that time, *two hundred and sixty-five years ago*, there was considerable traffic in furs between the Micmacs and the Frenchmen on the St. Lawrence, Tadoussac on the Saguenay, being then the chief French settlement. The Indians at Port Royal had iron implements in their possession, which they obtained from traders, but no fire arms. There was then resident near Campseau (Canso,) which was well known, an old trader, a Frenchman of St. John de Lus, who had made forty-two voyages between Europe and these parts. Pictou harbour probably, and all the harbours of the coast, were then well known to Europeans.

A specimen of the Carolina Dove (*Columba Carolinensis)*, forwarded by Mr. POOLE, of Glace Bay, C. B., was exhibited. It had been shot in that locality recently.

Mr. T. F. KNIGHT read a paper "*On Natural History and its place in the Sciences.*" (See Transactions.)

The Secretary (Mr. W. GOSSIP), concluded the reading of a paper "*On the Antiquity of Man in America.*"

Members elected.—Professor H. V. HIND; Messrs. E. MOSELEY, FRED. D. ALLISON, AUG. ALLISON, WILLIAM BARNES.

ORDINARY MEETING, APRIL 13, 1869.

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

Mr. P. S. HAMILTON (by request) read a paper by Professor DAWSON, F. R. S., entitled "*Notes on new points and connections in Acadian Geology.*"—(See Appendix.)

Mr. ALLISON (by request) read a paper by Mr. HENRY POOLE, "*On the Meteorology of the Glace Bay Coal District, Cape Breton*, 1868."—(See Transactions.)

Mr. Allison afterwards compared the temperature of Halifax with that of Glace Bay, and showed that the mean temp. of Glace Bay was 2° 83′ below that of Halifax. The mean temp. of each month was also lowest at Glace Bay. The minimum temp. 2° below, and the maximum temp. just the same.

Professor H. V. Hind followed with "*Remarks upon the Geology of the Waverley Gold Fields.*" (See Transactions.)

Ordinary Meeting, May 10, 1869.

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

Mr. F. Allison read a paper, "*Meteorological Observations at Halifax, 1868.*" (See Transactions.)

Dr. J. B. Gilpin read a "*Note on the Walrus (Trichecus rosmarus) recently brought from Newfoundland.*" (See Transactions.)

An excellent drawing illustrated the paper.

Dr. A. C. Cogswell exhibited several highly interesting microscopic forms, including *Trichina spiralis,* obtained from the human subject at Philadelphia.

Mr. A. Downs exhibited a fine male specimen of the Scarlet Tanager, (*Pyraya rubra*), which had been recently shot near Halifax.

Extra-Ordinary Meeting, June 14, 1869.

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

Professor How submitted a paper "*On Coals and allied Minerals.*"—(See Transactions.)

Mr. Haliburton communicated a paper "*On an important reclamation of Land in Sackville, N. B.*" By R. Carr Harris.—(See Appendix.)

Mr. J. M. Jones read a paper "*On Nova Scotia Coleoptera.*"—(See Transactions.)

J. M. J.

DONATIONS TO THE INSTITUTE.

SEPT. 1, 1868, TO AUGUST 31, 1869.

The Provincial Legislature $100.00

LIBRARY.

IN EXCHANGE.

Boston.—Boston Society of Natural History—Memoirs. Vol. I. Part 4.
" " " " Proceedings. Vol. XII., pp. 81-419.
" " " " with Index.
Montreal.—Canadian Naturalist.—Jan. 1868—Vol. III. Part 5, 6.
New York.—Engineering and Mining Journal.—September to December, 1868. January to August, 1869.
Philadelphia.—Journal of Franklin Institute. Sept., Oct., Nov., Dec., 1868.
Salem.—Proceedings of Essex Institute. Vol. V. No. 8.
Toronto.—Entomological Society of Canada—Canadian Entomologist. Vol. 1. and Vol. II. Part 1.
" Canadian Journal. Dec. 1868. April, 1869. July, 1869.

PRESENTED.

Boston Society of Natural History. Entomological Correspondence of Thaddeus William Harris, M. D. Edited by S. H. Scudder.
Peabody Academy of Science, Salem.—First Annual Report of the Trustees.
The Natural History Society, Portland.—Donations to Museum and Library.
Professor Dawson, F. R. S.—Acadian Geology. 2nd edition.
" " " Modern Ideas of Derivation.
Department of Mines, Halifax.—Report of Waverley Gold District. By H. Voule Hind, F. R. G. S.

LIST OF MEMBERS.

Date of Admission.			
1863.	June	24.	Almon, Hon. M. B., Hollis Street, Halifax.
1868.	Mar.	3.	Allison, Frederick, Carlton Street, Halifax.
1869.	Feb.	8.	Allison, Augustus, South Park Street, Halifax.
1869.	Feb.	8.	Allison, Frederick D., Kent Street, Halifax.
1868.	Feb.	1.	Belemore, Dr., R. A., Artillery Park.
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., Granville 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.
1869.	Mar.	1.	Dakin, G. W., Cornwallis Street, Halifax.
1863.	Oct.	26.	DeWolf, James R., M.D., Edin., L. R. C. S., Vice President.
1863.	Dec.	7.	Downs, Andrew, *Cor. Mem. Zool. Soc., London*; the Village, near Halifax.
1863.	Feb.	2.	Duvar, J. Hunter, Prince Edward Island.
1864.	Oct.	26.	Finnie, A. S., Bank of B. N. A., Halifax.
1866.	Feb.	1.	Forman, James, Thornfield, near Halifax.
1868.	July	23.	Foord, A. S., Bank of B. N. A., Halifax.
1863.	Jan.	24.	Fraser, R. G., Spring Garden Road, Halifax.
1867.	Nov.	4.	Fraser, T. R., M. D., Argyle Street, 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., Spring Garden Road, Halifax.
1863.	Feb.	2.	Gossip, William, Granville Street, Halifax, Hon'y Secretary.
1868.	Dec.	8.	Greville, Lieut Col. R. A., Artillery Park.
1868.	Mar.	3.	Grove, W., Halifax.
1863.	Jan.	26.	Haliburton, R. G., F. S. A., North West Arm, near Halifax.
1863.	Oct.	26.	Hamilton, P. S., Granville Street, Halifax.
1863.	Jan.	26.	Hardy, Capt. C., R. A., Chatham, England.
1863.	June	27.	Hill, P. Carteret, D. C. L., Morris Street, Halifax.
1869.	Feb.	8.	Hind, Professor H. V., Windsor.
1863.	Mar.	11.	How, Henry, D. C. L., *Professor of Chemistry, King's College, Windsor.*
1869.	Jan.	15.	Hudson, J., Albion Mines, Pictou.
1867.	April	1.	Jennings, Edward, M. D., Halifax.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., President, Spring Garden Road, Halifax.
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., *Acting Auditor*, 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., R. A., Artillery Park.
1869.	Mar.	8.	L'Estrange, Lieut. Col. P. W., R. A., Artillery Park.
1865.	Nov.	9.	Lordley, E. J., George Street, Halifax.
1868.	Oct.	23.	Mainwaring, Lieut. A. R., R. A., Artillery Park.
1869.	Jan.	19.	Morley, Lieut. C., R. A., Artillery Park.
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.	Mar.	1.	Outram, Joseph, junr., Bedford Row, Halifax.
1867.	Sep.	25.	Parker, Van Ess., M. D., Halifax.
1863.	Jan.	5.	Poole, Henry, Glace Bay Coal Mines, Cape Breton.
1866.	July	28.	Reeks, Henry, F. L. S., Manor Hall, Thruxton, England.
1869.	Jan.	11.	Roue, J., Hollis Street, Halifax.
1866.	Jan.	8.	Rutherford, John, *Chief Inspector of Mines*, Province Building, Halifax.
1868.	Jan.	6.	Rule, Lieut. C. G., R. A., Artillery Park.
1864.	Mar.	7.	Silver, W. C., Queen Street, Halifax, TREASURER.
1868.	Oct.	14.	Scholfield, J., Birmingham Street, Halifax.
1865.	Jan.	9.	Sinclair, Lieut. Col. R. B., A. G. M., Halifax.
1865.	April	20.	Smithers, George, Granville Street, 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, in Halifax.
1863.	April	15.	Willis, J. R., *Cor. Memb. Bost. Nat. Hist. Soc.*, et *Liverp. Micro. Soc.*
1866.	Mar.	18.	Young, *Sir* William, Kt., *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.
1864.	July	1.	Marett, Elias, St. John's, Newfoundland.
1865.	Dec.	28.	Morton, Rev. John, Trinidad, West Indies.
1869.	Jan.	9.	Ross, Angus, Goldenville, Guysboro'.

CORRESPONDING MEMBERS.

1869.	Jan.	18.	Bethune, Rev. C. J. S., Credit, Ontario.
1866.	Sep.	29.	Chevallier, Edgcumb, H. M. Naval Yard, Pembroke, England.
1866.	Feb.	5.	Hurdis, J. L., Lower Chamberlayne Place, Southampton, Eng.

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. V.

(*Read November*, 1867.)

In the last paper I had the honor of reading to you, you will recollect that I enumerated and classed all the mammalia of the Province, and also described the somewhat aberrant group of the otter, the skunk, and the raccoon. This evening I shall devote to the American bear, our largest carnivora, and our last, according to the classification adopted by the author of North American mammals—and then I shall take up the rodents.

The American Bear.

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

This well known animal which, unlike very few, is honored by no synonymes, no one seeming to deprive the learned Russian of his original specific, is too familiar to naturalists to warrant a minute description. The few facts I may have obtained personally, through our Indians and hunters, of his habits in our Province, will best fill the paper. From the European bear (U. Arctos) he specifically differs, in his less size, his tawny muzzle, and tendency to tawny spots and stripes down his breast, in his arched profile, and pointed nose, in his darker colour, and his having according to LeConte, one more molar tooth than the latter. His hair when in good condition, is lustrous black, with a sub-layer of soft wool. I have had mittens knit out of yarn spun from it.

A lady well known some half century gone in the Province, when a girl assisted by her companion killed a large bear, which came down on the solitary farm house in which they were alone. In his attack on the hogpen he got himself caught in the rails of a fence. Whilst one girl sat upon the rail, the other despatched him with a rusty carving knife. The knife was dull, the hand unsteady, the operation prolonged, and the bear's struggles and cries appalling. In after life this girl become a matron, kept a shirt wove of the wool from her mangled victim, and clad her first-born, and each succeeding new-born son in this hair shirt, to give him courage and strength. They all grew up men of undaunted spirit; but the first-born in after years became a Royal favourite, and left his life's blood on one of the Canadian battle grounds, in the war of 1812 with America.

In Nova Scotia the bear regularly hybernates, going into winter quarters late in November, or early in December. He seeks, the Indians say, usually during a snow storm, the upturned root of a fallen tree for a shelter; sometimes a projecting rock, or, beneath a heavy log, serves him. Here he becomes fast snowed up, leaving a small hole, around which hangs often a vapour, said to be his breath, but more probably caused by the heat of his body. The female seeks an earlier and more intricate seclusion, and it is during this period that gestation must take place. This demand for a second life is made upon her, taking no food herself, and seemingly ill prepared for its duties. The Indians and hunters say that there has been no instance of a she-bear being taken with young,—that if disturbed, she always aborts, and that the young are born no larger than kittens. We can only receive these stories, which, however, are universal from here to the Polar Ocean, and which her hybernated state during the time certainly accords with. March or early April sees them out again, and not so much out of condition as one would suppose. In captivity he rarely hybernates. Capt. Moody, (Secretary to his Honor Sir Hastings Doyle,) informed me he knew one which regularly hybernated at Mirimachi, a chain disappearing down a deep burrow beneath a stable being the outward sign of his retreat.

When seen in the open he is usually shuffling off a brisk retreat, going high behind with a rolling gait, his head and tawny muzzle ever and again turned over his shoulders. On the blueberry barrens, when the low thick mist disappears before the red September sun, the Moose hunter returning from his night's bivouac sometimes surprises him, sitting upon his haunches gathering in with his hairy paws the berries he loves, and muttering a low whimpering growl, and turning his head and pointed nose in ceaseless circles. It is astonishing with what celerity he retreats. No chance to cover him with the ready gun, the dew dried upon the grass and bushes where he sat, whilst the crystal drops are steeping elsewhere, the broad barren is his only sign. The male bear has the habit of rising upon his hind legs and sticking his claws into the bark of trees, like a cat against a table leg, at the same time snarling, growling and foaming at the mouth. I have often seen trees thus torn, and old rotten logs torn into pieces in his search for maggots. When it happens in a line of country, that a long narrow ravine, water course, or gorge, descends from the forest into the open, making as it were with its steep and wooded sides a covered way, this country becomes famous for a bear country. The farms all about suffer in their young cattle and sheep. Here it is that the deadfall and steel trap are set, when the alarm of a bear being seen, is given. Sawmill Creek, about four miles from Annapolis Royal, has had this bad reputation for ages. It is often asserted that we have two species in this Province, a brown and a black variety. This is not true. I have seen brown bears, from their old sun-tanned coats falling off, become black; I have also seen brown and black cubs, seemingly of the same litter.

Of his food, most probably before the Province was settled, it was nearly vegetable. The varying hares seem almost the only indigenous mammals within his reach; a few fish, frogs and fresh water clams may have been added to his diet in early spring; but the innumerable quantity of berries, beech nuts and acorns, give him that savoury fat that fits him for his wintry sleep. Now his diet is not only varied by the wild apples so often found in old clearings in the deep forest, and which he and the porcupine greedily seek, but the young cattle and sheep of the settler afford him many a meal. He never attacks old cattle, but creeps upon and surprises yearlings, springing upon their withers. I have frequently seen working cattle, which still bore the scar of deep flesh wounds, made when yearlings, and which have escaped from his clutches. From all these sources he keeps himself in good case, especially as during the winter he need not provide, an advantage which one easily understands who has seen the gaunt spectre of a hungry lynx or wild cat, made reckless by famine, leaving the wintry forest and prowling by day in our back yards and town gardens. I have seen him far off by day, and crossed his path at night in riding in the forest; though turning upon the dogs his instinct was to retreat.

Except when her cubs have been taken, the she-bear undauntedly charges the spoiler, I never knew but one instance of a bear pursuing a man. This man riding in the forest was pursued for two miles. He gave little heed to it at first, but the beast was so dogged, that he put spurs to his horse to rid himself of a pursuit that only stayed when he reached the open. Of the danger of approaching a wounded bear, even when seemingly dying, an unhappy occurrence at Annapolis Royal was a warning for many a year. Towards night, a bear that had been hunted the livelong day, desperately wounded, sought a deep ravine to await his fate and fast approaching foes. The foremost man, armed only with an axe, fired by the thoughts of killing the animal, which lay before him with head to ground, and bleeding from mouth and nose, closed with him. Instantaneously he was seized in a grasp which was only relaxed as both fell dead together; a rude barrow of branches served to carry both from the steep ravine. An eye witness, who helped carry the double burden, told me this. On the other hand, the very frequent stories of children seeing him on their way to the lonely school, attest his comparative harmlessness. His flesh is not unsavoury when cooked as cutlets, tasting both of pork and veal; the hams when smoked are dry and tasteless, and very inferior to pork. He is by no means diminishing in our Province, and we may speculate that perhaps our earliest carnivora, which may have put in his first appearance as a vegetable eater, until taught by the lynx and wolf the taste of blood, may be our last. His shiftiness, now a berry finder, now a grub hunter, anon going to the lakes for food; his hybernation, and frequently when enforced, his ability for so large an animal for keeping close cover, and the increasing food of sheep and young cattle that our advancing settlers unwittingly spread for him, all attest that for ages to come Nova Scotia will not be without its bear.

RODENTIA.

The Red Squirrel.

Sciurus Hudsonius, (Pallas.)
Sciurus Hudsonius, (Richardson.)
Sciurus Hudsonius, (Audubon, Bachman.)
Hudson's Bay Squirrel, (Pennant.)

Description of a fine specimen of this beautiful little animal, taken 14th Novr., 1862, near Halifax:—

The head arched, nose rather blunt, ear rounded, hairs on the inside, both anterior and posterior edges turned inward, a few long hairs approximating to a pencil on the tip; teeth reddish brown. On the fore extremity four toes, with a rudimentary thumb, third the longest. Palm naked with five tubercles; on the hind foot there are five toes, four tubercles at the base of the toes; the sole is well furred up to the tubercles. Colour—margin around the eyes, sides of upper jaw and chin, white; breast, belly and inside of legs whitish, with slate grey mixed through them, each hair in many instances annulated grey and white; above, on head, back and sides and outside of the legs, there is the same slate grey at the base, but the tips of the hairs are washed by a most beautiful chestnut red, which commencing on the forehead becomes very intense at the back, spreads down the back and sides and outside of the legs, and ends in the tail. The tail is flat, well spread with a margin of blackish hair all around it. The hairs at the end being very long and partially forked; the fur is thick and full, that on the back lustrous. The whiskers are black; in some instances a black line along the side divides the chestnut from the grey of the belly.

Extreme length to end of hairs on tail $12\frac{3}{4}$ inches.
Extreme length of tail to end of hairs, $5\frac{3}{4}$ inches.

This charming little animal is an inhabitant of the spruce fir wood throughout the year. In summer he is seen in the clearings, and as often running along the topmost rail of the rude fences.—In winter he seeks the dense forest. According to Richardson, he makes a burrow in the fur countries, and stores away pine cones for winter use. With us he sometimes makes a nest in the branches of a spruce fir tree. I believe farther south he habitually does, making no burrow, as he lays up no winter stock. He does not hybernate, but during very bad weather he lies by for days. He is seen during the coldest winter days running from tree to tree, or skerring over the snow-clad rocks, and usually alone. Now he pauses, now flings his head and tail up with perpetual jerk, then scuds off into a hole. Returning he indulges in a scolding match of short shrill barks, stamping his feet and evincing every mark of passionate anger. If you approach him he makes off, straddling his hind legs, and flattening his back to a level of the old log on which he makes his running. The winter camps of the loggers become infested with them. The men have scarce left their camps for their work, than the silent rude structure is attacked by an army of invaders; every hole, every crack and orifice is pryed into, an entrance is made, and perhaps, a half barrel of hard bread has been removed by these red pilferers before the men return for the night. Hard biscuit, perhaps from its resemblance to nuts, and beech mast, is a very favourite food. During autumn they approach the villages and gardens in numbers. I have counted seven in sight, and again they appear to migrate, as for several years they are scarcely seen in that section of the country. This truly boreal member of our fauna is so conspicuous an ornament of our dark pine woods, that we may hope his lustrous red will for ages contrast with the dark sombre of our forest, his short startling bark awake its solitudes, and his brisk jerking scud over fallen tree and snow-clad rock enliven our austere landscape.

SEVERN RIVER FLYING SQUIRREL.

Sciurus Hudsonius, (Gmelin.)
Pteromys Hudsonius, (Baird.)
Pteromys Sabrinus, (Richardson.)
Pteromys Sabrinus, (Audubon, Bachman.)
Severn River Flying Squirrel, (Pennant.)
Asapan, of early American voyages.

Description of a fine male given me by Mr. J. R. Willis, Halifax, N. S.:—

Head short, and nose round, eyes very prominent, ears moderately large and sub-pointed, whiskers black. On the fore foot are four toes, and a large ball almost a rudimentary thumb, the palm naked, with four tubercles; on the hind foot five toes with four tubercles, sole naked. A membrane covered by hair of the same quality as the body extends from the wrist of the fore foot to the heel of the hind. A bone three-fourths of an inch long is articulated on the wrist, which seems to keep the

membrane expanded when in use, but when not in action lies folded parallel with the fore arm. It is peculiar that this bone is not as in the case of the bat, a prolonged toe or digit, and as also is the case in the swimming paw of the seals, and the feet of ducks, but a bone "*sui generis*," though most probably its type would be found in the carpal bones of all mammals. With the exception of the bat this is the only instance of both extremities being used in forming the wing, considering the great Indian flying fox to belong to this genus The flying lemur, (galiopithicus) of DeBlainville, seems to have some analogous structure. The fur of this little animal is very soft, silky, and long. The ears appear to the casual observer naked, but are covered both inside and out by very fine fur. The colour on the forehead, back, and upper side of flying membrane, is light reddish brown, but this colour extends only to the ends of the hair, which beneath is lead colour. This lead colour shows itself in streaks in many parts of the body, and in rather broad patches on shoulders and thighs, the head is rather lighter than the back, and the upper surface of tail fades into a fawn with a few dusky hairs, forming a mesial line and tip; chin and lower part yellowish white, with a buff wash that becomes more intense on the lower side of tail. With the exception of chin and a narrow breast line where the hair is white at the root, the white surface has lead coloured roots. I am the more particular in this, because one of the specific differences between this species and P. Volucella, a smaller species in the New England States, is, the latter has no lead coloured base to its fur.

Extreme length to end of tail	11 inches.
Length of tail	5 inches.
" of wrist bone	$\frac{3}{4}$ inch.

It is singular that Richardson makes no mention of the wrist bone, but rather makes a new species founded upon the projection of the flying membrane, though this rounded projection is only caused by the bone being extended during flight.

This singular animal to which the peculiar name Asapan has been given by the old voyagers, is not rare with us; but having its abode in the most secluded forest, and being nocturnal in its habits, is seldom seen. It makes warm nests for itself in hollow trees, where it produces four or six at a litter, and where it also hoards its stores of cones and beech nuts. When disturbed from its abode during the day it ascends the highest trees, and jumping from the topmost branches either sails before the wind and catches the tops of other trees one hundred yards or so distant, or comes fluttering to the ground at double that distance. I have often mistaken them for dead leaves falling to the ground. They have usually three or four holes to their nests; by blocking up all but two, spreading a stocking over the one, and smoking a cigar in the other, you will soon be rewarded. In their precipitous escape from the smoke they rush headlong, two or three at once, into the stocking. Thus taken they are easily tamed, become fond of sleeping all day in your pocket, but are abroad all night, and carry off and secrete in bureaus and table drawers all nuts in their reach. In flying they appear to have but little power of direction, and none of ascension.

As I have before mentioned a smaller species replace ours to the south. I must confess that I have drawn my observation of the habits of this species from some of the captives of the stocking and cigar, in the New England woods, though there can be no doubt of their entire similarity of habits. Dead specimens, stuffed ones from my friends' collections, or living ones kept in cages, of our species, are the only ones I have had access to. A larger and finer animal with a somewhat more sombre colour, he yet must content himself with a less variety, and a scant and meagre fare of pine cones and beech nuts, and long winter naps, to eke out his frugal larder, instead of the profusion of chestnuts, walnuts, and shellbarks spread before his more southern representative.

American Ground Squirrel.

Sciurus striatus, (Linn.)
Sciurus (*Tamias*), *Lysteri*, (Richardson.)
Tamias Lysteri, (Audubon, Bachman.)
Tamias striatus, (Baird.)
Ground Squirrel, *Striped Dormouse*, (Pennant.)

The great Swede was the first to describe this little animal, which he included in the genus Sciurus, taking the description from an American specimen. The genus Sciurus being justly divided into "Tamias," Richardson supposing that the specific "Striatus" referred to the European species, and knowing that they were distinct, adopted the specific "Lysteri," for the American, but Baird justly restores it, since although Linnæus supposed them identical, yet it was the American species which he described, and therefore the name, if it belonged to either, did to it.

From a skin before me, from the collection of J. M. Jones, Esq., I find the measurements to be—

Total Length........................11 inches.
Length of Tail......................4 inches.

In colour the head is brownish, with white stripes through the eye, the back of a delicate French gray, the sides yellowish brown, lighter than the head, and the rump a fine chestnut red; the tail of reddish brown with the tip and a margin each side black; the under parts are light. On the back there are five black stripes, extending the middle or dorsal one from back of head, the central ones from top of shoulder down to the chestnut red of rump. The dorsal stripe has a reddish border on each side; the four other stripes are margined outside with red, but between each pair there is a white stripe which takes the place of the reddish border.

This complicated colorization is easily seen but difficult to describe. The ears are small and covered inside and out by fine hair. Four toes with a rudimentary thumb, are on the fore foot, and five upon the hind. This genus "Tamias," separated from the tree squirrels by their burrowing habits, their different dentition, their cheek pouches, pointed nose and thin tails, are the connecting link of the true squirrels and the gophers or pouched rats, and are connected on the other hand with the Spermophiles. This genus is both restricted and well marked, restricted to six or seven individuals, all of which are well marked by stripes.

They are tolerably numerous in our Province, where their quick angry bark enlivens the solitude of the steep woody dell in whose sides they burrow, and where their quaintly painted forms give a touch of colour to grey rock or old rotten log, as with laden cheek pouches, mindful of pinching winter, they scud on their daily avocation. Towards the last of October they retreat to their burrows, returning again of a warm April day. They probably sleep much of their time, but do not hybernate so profoundly as the bear or jumping mouse, which as they require none, lay up no winter store.

Unlike our red squirrel, which seeks your society, and is saucy, inquisitive, and prying, these burrowing squirrels are solitary, avoiding notice, and unsocial. In confinement they sulk, resist kindness, and bite, and never use the turning wheel.

The Wood Chuck.

Mus. monax, (Linnæus.)
Arctomus monax, (Gmelin.)
Arctomus monax, (Richardson.)
Arctomus monax, (Baird.)
Arctomus empetra, (Numerous systematic authors.)
Quebec Marmot, *Maryland Marmot*, (Pennant.)
Ground Hog.

Of fourteen systematic and trivial names by which this solitary little earth burrower has been honored, I have selected such as will bring him down from his first illustrious describer, to the most modern English and American writers. I may add that about thirty naturalists since 1751, now one hundred and ten years gone, and the date of Linnæus, first description, have written upon him.

The description of several skins before me collected at Halifax, N. S., would read :—

General appearance above hoary brown. There are two kinds of hair, a short woolly fur interspersed with long shining hairs. These long hairs are coloured at base bluish black, then brown, then black, then white, and finally tipped with black. They prevail all over the body but are very much longer and more numerous on the shoulders, giving a ruffed look to that part. The tail is also covered with long stiff hair, but these are of a uniform yellowish brown, with an obscure dark bordering. The head and forehead are dark brown, a grizzly ring around the nose, the tip of nose black and the cheek and throat greyish. Beneath there is a fine chestnut red, the hair is coarse and thin ; the mesian line very much pronounced ; the feet are black, the leg partaking of this chestnut hue, which is much more intense on breast and side of belly than mesian line. I have been the more minute in these colours, as they differ from the more southern species, which according to Baird and Audubon, and Godman, have no long hair over the shoulders, and from Baird are nearly black above, and black and grizzle, mixed with the chestnut red of the belly. In these differences they approach "pruinosus" of Pennant ; indeed with the exception of the dark line running vertically downwards from behind the ear, almost identical. In some of our skins there are dark penciling of the long hairs which might almost be taken for the lines. I cannot but suppose that Pennant's first description of "pruinosus" was taken from a northern specimen. A more minute study and comparison of many specimens must be made before "caligata," "okanagan" and "flaviventa" can be separated from "pruinosus," which I think hereafter will become a northern specimen of Monax.

A female specimen taken from an Indian's dog, Kentville, N. S., 20th May, 1861, measured—

Total length..................	$22\frac{5}{10}$ inches.
Length of tail................	$6\frac{6}{10}$ "

Another female sent me by Sgt. Kavanagh, Margaret's Bay, 24th May, 1861—

Total length..................	$19\frac{5}{10}$ inches.
Length of tail...............	$5\frac{4}{10}$ "

The general appearance of both the specimens, was, on the upper parts, hoary brown with black, feet black, under parts chestnut red. On looking down upon them, the nose was light hoary, forehead brown, cheek and band extending over the shoulders, light yellowish hoary, with long shining hair, the back and tail brown again, with shorter fur, tail flattened inclined to a double point. There were eight mammæ, two in the axilla, two inside of fore leg, and four inguinal. The very great development, especially in the large specimen, of the masseter muscle, gave them an appearance of cheek pouches. As all our specimens agree in the white ring around the nose, the black feet, and chestnut red belly, with the more southern specimen, we must suppose they owe this longer and more hoary fur upon back to their northern origin. Of their habits in the forest I have studied but little. They generally affect a barren stony side hill for their burrow, not in the deep forest but on the outskirts of settlements, and as I never have heard of their ravages in the clover fields, I fancy they are not very numerous in our province. A young one that I saw in confinement was very graceful in its attitude, sitting upon its haunches with its tail brought forward like a squirrel and using its fore paws. As they advance in life in confinement, they become loaded with fat, and clumsy in their movements; they have the habit of flattening themselves to the ground. When going on all fours, they have the high back and steep cut off rump of the guinea-pig. The nose is somewhat pointed though the head is blunt or rounded. Another favourite attitude is to sit upon their haunches with the head thrown upwards and to one side, the fore paws hanging down flattened to the body. They hybernate regularly in confinement, on the approach of cold weather, but may easily be roused from insensibility, by being placed before a warm fire.

ART. II. On a Peculiarity in the Block-house Seam, Cow Bay, Cape Breton. By John Rutherford, M. E., *Inspector of Mines.*

(*Read January* 18, 1869.)

The carboniferous formation which borders the eastern shore of Cape Breton, does not in its general features differ much from other coal-producing localities. The position of the coal measures has been ascertained over a distance of about fifty miles, extending from Miré Bay on the south, to the syenitic range which forms the promontory of Cape Dauphin on the north, against the southern

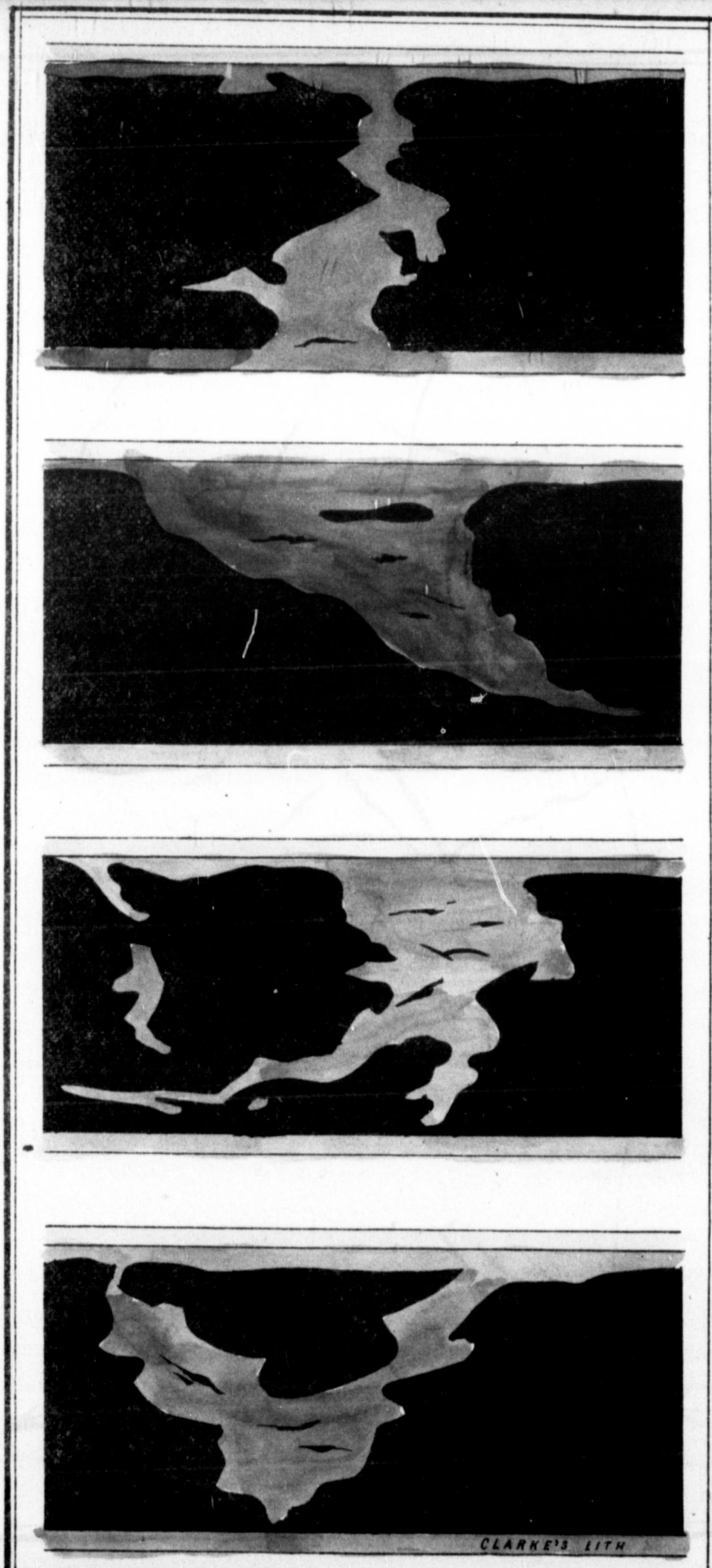

DIAGRAM I—BLOCK HOUSE SEAM

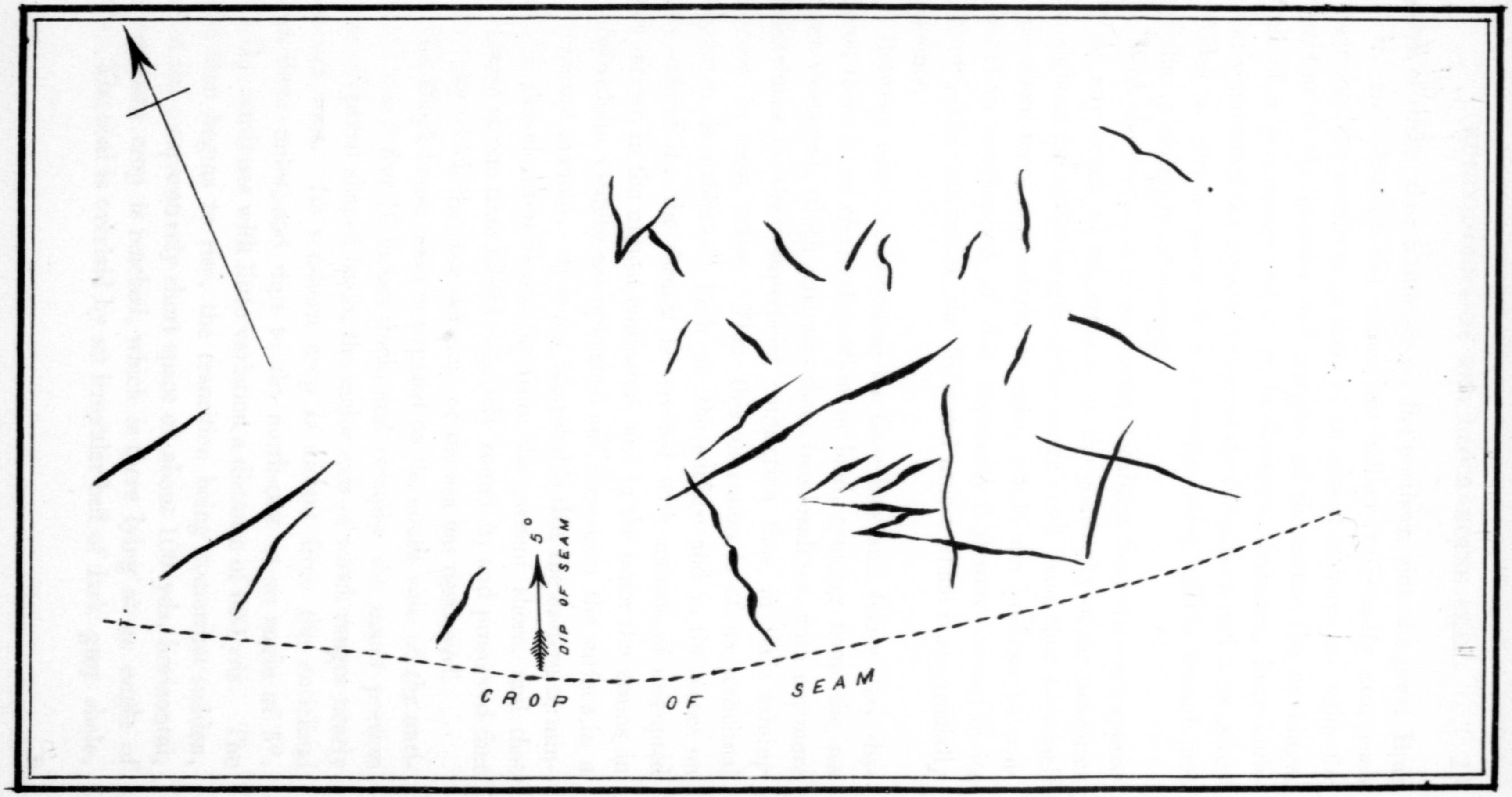

DIAGRAM 2 — SHEWING POSITION OF MASSES OF STONE IN THE BLOCK HOUSE SEAM REDUCED FROM PLAN OF WORKINGS.

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flank of which they terminate on the northern side the great Bras d'Or, and although the mines are neither sufficiently near each other, nor the workings in them of an extent to leave no room for doubt as to the identity and number of the seams, the openings, both of a permanent and of an exploratory character, have sufficiently indicated the general shape of the formation, and have given besides to certain parts of it a configuration which, though not peculiar is certainly interesting.

With the exception of one or two localities there does not appear to be any break of importance in the continuity of the measures throughout the entire length of the range; and even that to which I am about more particularly to refer, would not perhaps be considered an interruption of this regularity if it were viewed in its entirety, and not under the divisional aspect which it superficially presents.

Between what are known as the Cow Bay and Glace Bay districts, there is an elevated portion of land, ranging from the sea shore westward, which separates these two localities, with not more distinctness in their superficial connection than in their mining relation to each other. That this elevation is of an anticlinal character, is evidenced both on the surface and in the mines on each side of it; the former is covered with masses of disrupted rock strewn in the utmost confusion, and in the latter the seams in its immediate vicinity are upheaved and thrown to the surface in a very abrupt manner. It is not improbable that the eastern termination of this elevation is not far from the present shore, and that the seams at one time folded regularly round it, and preserved that continuity which the encroachment of the sea has destroyed.

The Block-house seam is situated on the south side of the anticlinal; it is 8 feet 10 inches thick, and occupies the upper portion of an elliptical shaped basin, the major axis of which ranges nearly east and west. Its southern crop is distant from the anticlinal about three miles, and dips to the north-east at an angle of 5°. This dip continues with little variation a distance of 600 yds. The seam then begins to rise, the transition being somewhat sudden, and in the comparatively short space of about 100 yds. horizontal, the northern crop is reached, which is there lying at an angle of 45°. The coal is overlaid by an irregular bed of dark grey shale, varying in thickness from 1 ft. 6 ins. to 6 ft., above which there is a hard sandstone five feet thick. No dislocations of any importance have been met with in the workings, and with the exception of the peculiarity which forms the subject of this paper, this very fine seam of coal is of a most regular and uniform character. This peculiarity consists of masses of stone similar to that overlying the coal, which with a frequency very undesirable as regards cost of working, range through the seam in a very extraordinary manner. Without exhibiting the slightest change in thickness or quality, the coal appears in some cases to terminate as it were against a wall of rock. On cutting through this, however, it is again found in its regular position, the planes of the floor and roof being unbroken, and the coal of its usual quality.

These interruptions, for they are not faults, vary much in thickness; in some instances they are only a few feet thick next the roof, and are thinned down to a wedge-like point near the bottom of the seam; in others they are much thicker, 32 feet of stone having been passed through at one place. The wedge shape is a prevailing form, but it is inserted, if I may use the term, in the most irregular and fantastic manner; in some places it is nearly vertical, and in other it is in an oblique position. It is difficult to convey an idea by mere words of the variety of shapes in which these masses are found in the coal; the diagrams which I have prepared to illustrate the paper are copies of sketches made by myself in the mine, and represent sections of the stone as exhibited on the sides of the openings made in working the seam. There is generally near the roof a portion of the stone strongly slickensided, which gives it when found in an angular position with the plane of the roof, the appearance of a fault; but in cutting through it the coal is found on the other side, undisturbed. Not unfrequently pieces of coal are found embedded in the stone, and it often happens when the workman is preparing a hole for blasting, that he chances to drill into some of these, and the operation is much expedited in consequence. I may here state that although when first met with the stone is generally so hard as to require the use of powder to remove it, it becomes in the course of a few weeks like moistened clay, and may be easily squeezed between the finger and thumb.

Another and a very striking feature is the detached pieces of stone of the same character as the larger masses; these are generally near the latter, and are in various positions in the coal; sometimes they are near the roof and sometimes close to the floor.

Such are some of the principal features of these peculiar interruptions in this otherwise evenly deposited and undisturbed seam. How these masses of stones have got into these shapes and positions is a question of some interest; for, although we may readily assume and with fairness, that the upheaval forming the anticlinal has caused the tilting of the northern edge of the basin, it is not evident how that movement could originate the peculiarities we have described.

When my attention was first directed to them I was curious to know whether any parallelism in their courses through the seam could be detected. Of this, however, I do not find sufficiently distinct indications to warrant any deductions from this feature as to their origin; they range through it in the most irregular manner, and are as variable in their length as in other respects. This is shewn in diagram No. 2, which is copied from the plan of the workings, and shows their correct position and relation to each other as found in the mine. It does not however represent a tithe of their number, those of smaller size not being noted.

An examination of all the circumstances leaves little reason to doubt that these masses have been thrust or squeezed into fissures in the upper part of the seam; they are of the same composition as the overlying bed, and there is this additional fact, that in very few instances that I could learn have they any connection with the floor of the seam. In nearly every case the thinnest part of the mass, the wedge-like point, is near the bottom of the seam, clearly shewing that the openings took place at the top of the coal bed as we see in mud creeks in dry weather.

The presence of the detached pieces of stone in the coal may be accounted for by the assumption of an unsolidified state of the vegetable matter of which the coal is composed, when the overlying bed was in course of deposition; and it is not at all an improbable supposition, that portions of carbonaceous matter might get mixed with the sedimentary deposit which filled the openings, and thus account for the streaks of coal in the stone. The evidence of pressure which caused a movement is afforded by the smooth markings of the stone, which are more especially observable near the top of the seam.

I may add as worthy of remark, that in no other seam in any part of the Province, have I seen any thing of a similar character. Whether the McAuley, which from its position as an underlying seam has its northern crop nearer the anticlinal, is in like manner disturbed, is not yet known, as that part of it which is immediately beneath the Block-house seam has not been opened; but in the Gowrie mine, where it is worked, there is not any thing at all resembling the peculiarity I have endeavoured to describe.

We can imagine disturbances affecting the underlying strata in such a manner as to cause the seam to be disturbed, that the upper part would be fractured and present openings which subsequent deposits would fill up; but we should expect the floor of the seam to exhibit corresponding irregularities. Such, however, is not the case in this instance; from its southern crop to the centre of the basin, the bottom of the seam is regular in shape, and rests conformably on the strata beneath it, the plane of which is unbroken.

It seems therefore that some unusual conditions have existed during the formation of the Block-house seam, which have not occurred at an earlier period.

ART III. GEMS AND THEIR APPLICATION TO THE ARTS. BY A. S. FOORD.

(*Read January* 18, 1869.)

I HAVE considered that a few facts relative to the mode of occurrence and natural appearance of gems, may not be uninteresting to those who reside in a country like Nova Scotia, abounding in almost every species of mineral wealth, and I have selected the following stones as being those universally valued for their beauty, rarity, and distinctive character, namely: the *Diamond*, the *Ruby*, the *Sapphire*, the *Emerald*, the *Beryl*, the *Topaz*, the *Amethyst*, the *Opal*, the *Garnet* and the *Turquoise*.

I shall commence with the diamond, which now holds the most prominent position amongst gems.

A great deal of confusion exists between the ancient and modern nomenclature of precious stones, the names of some having as it were, changed places; thus, the term *adamant* of the early Greek writers was often erroneously applied to the diamond.

The first indisputable notice of our modern diamond occurs in Manilius, a poet of the latter Augustan era.

The eminent Roman naturalist Pliny, calls the diamond the companion of gold.

A modern authority on this subject, the author of a valuable work on antique gems, considers that the celebrated philosopher may have only stumbled on this truth by accident; but it still remains the fact that all diamond mines of which we know anything have been brought to light in the pursuit of gold. This was notably the case in Brazil, (Golconda seems to be an exception, for India possesses no gold mines,) but the frequent occurrence of diamonds in Australia, together with their still more recent discovery at the Cape, go far to prove the close association that exists between these minerals and the precious metal.

Taking into consideration the great extent of the Nova Scotian gold districts, it seems not improbable that the diamond will be eventually discovered in one or other of those auriferous areas where alluvial workings are carried on.

Professor Tennant, of King's College, London, a thoroughly practical mineralogist, who has made this subject his particular study, considers the discovery of diamonds in British North America to be quite within the bounds of possibility.

Owing to its high refracting power Sir Isaac Newton pronounced the diamond to be a combustible body. It is infusible even by intense heat, provided air be excluded, but when exposed to the atmosphere and heated between the poles of a strong galvanic battery, it has been converted into coke and graphite; thus proving that this hard transparent body is only carbon in a peculiar form. In addition to its great brilliancy as an ornamental gem, the discovery of its curious chemical nature invests it with a high degree of scientific interest.

The origin and true geological position of the diamond has never been ascertained, though it has always been a subject of speculation, and it is the prevalent opinion that the carbon, like that of coal, is of vegetable origin, some crystals having been found containing black uncrystallized particles or seams presenting the appearance of coal.

Diamonds, with few exceptions, are obtained from alluvial washings. In Brazil the sands and pebbles of the diamond rivers and brooks are collected and washed by hand; under which process the diamonds are brought to light.

The diamonds of Brazil are seldom large, rarely exceeding 18 or 20 carats. One however, weighing 254½ carats, known as the *Star of the South*, was found accidentally in 1854 in the bed of a river.

The Island of Borneo, and also several localities in India, furnish this beautiful substance. It occurs in Hindoostan, in the district between Golconda and Masulipatam, and near Parma, in Bundelcund, where some of the finest specimens have been found. The once famous mines of Golconda have become nearly exhausted. In Borneo diamonds are obtained on the west side of the Ratoos mountains, with *gold* and *platina*.

The Brazilian mines were first discovered towards the beginning of the last century in the district of Serra do Frio, to the north of Rio de Janeiro.

Figure 1 represents a specimen consisting of a conglomerated mass of quartz pebbles, rounded from having been water worn, two crystals of diamond, one the size of a small pea, the other not larger than the head of a pin, and various grains of *gold;* the whole cemented together with oxide of iron. This specimen is especially interesting, as showing the association of diamonds with gold; it was brought by the late Mr. Mawe from the bed of a river in Brazil, who sold it to the Duke of Buckingham, and it is now in the possession of Mr. Ruskin, the well known Art-critic. Mr. Mawe states that when diamonds were discovered in the Brazils, they were used as counters for playing cards, the inhabitants being ignorant of their value, until the arrival of a person who, being struck with their geometrical symmetry of form, took a number of them to Portugal, where their true character was ascertained.

In the United States the diamond has been met with, according to Dana, in Rutherford county, North Carolina, and Hall county, Georgia. The same mineralogist makes the following statement with reference to the geological formation in which diamonds occur; "the original rock in Brazil," he says, "appears to be either a sort of laminated granular quartz, called *itacolumite*, or a ferruginous quartzose conglomerate." This kind of formation is in the Brazils called *cascalho*. In India the rock is a quartzose conglomerate or diamond conglomerate, containing pebbles of sandstone and quartz.

The diamond assumes a great variety of colours, namely, pink, blue, yellow, brown and black; the last being exceedingly pure, but without beauty, is only prized by collectors. The pure white diamond is most highly esteemed.

Diamonds are found in rolled pieces, in indeterminate and spherical grains, and also naturally crystallized. The form is usually that of the regular octahedron or cube, or some figure geometrically connected with these; as for instance, two four-sided pyramids, joined together base to base, or as dodecahedrons. Many of the octahedral crystals exhibit a very peculiar appearance, arising from the faces being curved or rounded, which gives to the crystal an almost spherical form.

The diamond yields readily to mechanical division parallel to the planes of the regular octahedron; and it is by taking advantage of its cleavage, or property of separating into natural layers, that the diamond is cut, as well as by abrasion with its own powder, or by sawing it with an iron wire; the latter, however, is a very tedious process, as the wire is generally cut through after it has been drawn across the stone five or six times. Being therefore composed of a series of infinitely thin laminæ—in a plane with the surface of the crystal—the diamond can be easily split. This discovery was turned to good account by a gentleman who used to buy large ill-shaped diamonds at a low price, and subdivide them into more perfect crystals.

A remarkable instance of the ignorance that still exists respecting the true nature of the diamond was exemplified only two years ago on the discovery of the first stone of this description at the Cape of Good Hope. It was supposed this substance was of sufficient hardness to resist the blow of a hammer. The diamond in question was accordingly taken to a blacksmith, who placed it on his anvil, and struck it with considerable force; I need hardly say what was the result—the diamond was shivered into a thousand pieces. It is a generally received opinion that the diamond, in consequence of its extreme hardness, will resist a blow of this kind. This is altogether a mistake: there is not a more brittle substance in nature than the diamond; although so hard as to scratch all other substances, it is, at the same time, so extremely fragile, that it would be a matter of great risk to let a valuable diamond fall upon the floor.

Besides the stone above mentioned, four more were found at the same locality—two of which were thus described in a paper read by Mr. Tennant before the Royal Geographical Society last Autumn.

"The first is in the shape of an octahedron, measuring in one direction three quarters of an inch, and in the other three-eighths, being therefore a compressed crystal. It presents a yellowish tinge of colour, and weighs 21 *carats*. This was found at Hope Town, on the Orange river, Cape of Good Hope. The second is an octahedron, more symmetrical, and was found June 7th, 1867. It weighs 8 carats. It is composed actually of two crystals, and in its present state it is worth £200.

Diamonds are cut by the following process: all irregularities are first removed by a slight blow of a knife; two diamonds are then set opposite each other on a couple of rapidly revolving discs, and are made, (having been previously covered with diamond dust and oil), to grind each other's faces. Steam power is used, and a number of wheels are set in motion in the same room. The business is confined to Amsterdam, and is entirely in the hands of the Jews, who employ about 10,000 workmen.

The following is the rule for estimating the value of diamonds. Square the number of carats, and multiply the sum by the selling price of a stone of one carat. For example, supposing the latter to be £8 (as it is at present), the value of a perfect brilliant of pure water of two carats would be $2 \times 2 \times 8 = 32$; the value of one of five carats, $5 \times 5 = 25$, which multiplied by 8 gives £200. Above 10 carats the price increases in such a rapid ratio, that few persons can afford to purchase the larger stones, and it therefore becomes difficult to sell them at their calculated value.

The average weight and size of diamonds may be learned from the results of an examination of 1,000 stones made by Professor

Tennant, who found that out of the entire number, one half weighed less than half a carat, 300 less than one carat, 80 weighed $1\frac{1}{2}$ carats, 119 varied from 2 to 20 carats, and one weighed 24 carats.*

In reference to the crystalline form of diamonds, out of 1,000 which came in the same parcel, Mr. Tennant found one of the shape fig. 6, which is rare; about ten like fig. 5; fifty like fig. 4, and the remainder like 1, 2, 3, in an equal proportion.†

Mr. King, the author of "Antique Gems," to whom I have already alluded, is full of information concerning diamonds of historical renown. The largest *authentic* specimen ever discovered (for the King of Portugal's weighing 1,680 carats labours under the disgraceful imputation of being topaz) was the "Mogul," so called because it was presented by a runaway servant of the King of Golconda to Shah Jehan, the great Mogul. It weighed originally $787\frac{1}{2}$ carats, but was reduced by unskilful cutting to 280. In form and size it resembles half of a hen's egg. The earlier history of the "Mogul" is often confounded with that of the "Koh-i-noor."

The magnificent diamond in the crown of the Emperor of Russia, known as the "Orloff," which formed the eye of a Braminican idol, was stolen by a French grenadier, who disposed of it at a very low price. It was afterwards offered to the Empress Catherine of Russia, who purchased it for £90,000 ready money, and an annuity of £4,000 more. In form and cutting it exactly resembles Tavernier's drawing of the "Great Mogul."

With regard to the "Koh-i-noor," or *Mountain of Light*, in the Persian language, Mr. King tells us that Tavernier saw it two centuries ago in the Mogul's treasury, soon after its discovery. It was found by a Golconda peasant while ploughing, and weighed in the rough 186 carats. It came into the possession of the British Government after the subjugation of the Punjaub in 1850, and was sent home to England, when it became the property of the Queen. It was shown at the Great Exhibition of 1851, when it was disfigured by a number of flaws (as indicated on the diagram.)

*** The carat is equal to about $3\frac{1}{6}$ grains, Troy.**

† The paper was illustrated by drawings of all the precious stones described, which we are unable to furnish.—*Ed. Trans.*

In 1862 it was again exhibited in London, amongst Her Majesty's jewels, after it had been recut by Messrs. Garrard. The present Koh-i-noor is what is technically called "a spread stone"—that is, it is shallow, with a large reflecting surface. The actual cost of recutting was £1,600.

From a careful examination of the stone before it was recut, Prof. Tennant arrived at the conclusion that it had originally formed a portion of a larger diamond, the form of which was a rhombic dodecahedron. He also suggested that the great Russian diamond, and another slab weighing 130 carats, had been taken from it. This division of the original dodecahedron into three was most likely the result of accident, as a very slight blow inadvertently struck, in the direction of the planes of cleavage, in setting the stone, or a fall, would have the effect of causing it to split. Possibly the slab alluded to above may have formed a diamond, with a flat surface, nearly as valuable as the Koh-i-noor, which Forbes, in his Oriental memoirs, describes as being with it in the royal treasury at Ispahan, and called the "Doriainoor," the "ocean of lustre."

The history of the Saucy diamond (weight 54 carats) is very curious. Nicholas Harlai, Seigneur of Saucy, its possessor, wishing to raise money upon it for the benefit of his friend, Henry IV., intrusted it to the care of a faithful servant. The man was beset by robbers and murdered. His master recovered the body, and calculating on his late vassal's fidelity, opened the stomach, where, as he expected, he found his lost treasure. He then carried out his intention, pledged it to the Jews, and was never afterwards able to redeem it. In 1649 it belonged to Henrietta Maria, Dowager Queen of England, from whom it passed to the Duke of York. After his abdication, the unlucky James sold it to Louis XIV. for £25,000. During the memorable days of September, 1792, it was stolen with the rest of the regalia; it reappeared in 1838, when the Princess Paul Demidoff bought it from an agent of the Bourbons for £75,000. In the winter of 1864 it was on view at Messrs. Garrard's, in London, and finally it has returned to its native land, having been purchased by the late Sir Jamsetjee Jeejeebhoy, of Bombay for £20,000.

The "Regent of France," the name of another celebrated diamond, (weight 136 carats,) was found by a slave, who hid it in a gash in his leg, and escaped to Madras. A rascally English skipper lured him on board his vessel, under pretence of halving the profits, and settled the claims of the poor wretch by pitching him into the sea. The skipper sold his ill-gotten booty to a native dealer for £1,000. The dealer resold it to Mr. Pitt, the Governor of Sumatra, for £12,500, who brought it to England, where its possession rendered him utterly miserable. He was so fearful of robbery, it is related, that he never made known beforehand the day of his coming to town, nor slept twice consecutively in the same house. In 1717 the Regent Duke of Orleans relieved him of his burden by a payment of £135,000. "It is," says Mr. King, "the most perfect brilliant in existence, and for shape and water without a rival."

The uses of the diamond in the arts are considerable. Those that are unfit for working are sold for various purposes, under the name of *bort*. This, reduced to a fine powder in a steel mortar, is used by jewellers, lapidaries and others. Fine drills are made of minute splinters of bort, which are used for drilling holes in rubies and other hard stones, for the use of watch-jewellers, gold and silver wire drawers, and those who require very fine holes in china, where rivets are to be inserted, and for piercing holes in artificial enamel teeth, or any vitreous substance, however hard. Cameos and intaglios are also cut by its means, as well as seals. All the gems are cut and polished with diamond powder, which is likewise employed for cutting rock crystal for those superior spectacles called *pebbles*. The value of the most inferior diamonds, such as are unfit for jewellery, is £50 per ounce.

The stones next in importance to the diamond, are the Sapphire and the Ruby—both consisting of the same chemical ingredient, viz: pure alumina, and belonging to the same family as corundum. The name *sapphire* is usually restricted in common language to clear crystals of bright colours, used as gems; while the dull dingy-coloured crystals and masses are called *corundum*, and the granular variety of bluish-grey and blackish colours is termed *emery*.

The following are the different descriptions of the ruby, and have received distinct appellations. The carmine-red variety is the *spinel*-ruby of the jewellers, the rose-red is called the Balas-ruby, so named from Balacchan, the Indian name of Pegu, whence this variety is brought; the violet spinel is the Almandine of Pliny, and the orange-red species is the Rubicella of jewellers. The best specimens come from the environs of Syriam, in Pegu. This gem is also found, but more rarely, in Ceylon, accompanied with Zircon or Hyacinth, and Tourmaline. It also occurs in the granular ejected limestone of Vesuvius, and in Bohemia.

The most remarkable oriental rubies mentioned, are two belonging to the King of Arracan, each of which was a six-sided prism, of the length of the little finger, and of about an inch in diameter at the base, a form which precludes the possibility of confounding them with any other stone.

The celebrated Marco Paolo says: "The King of Ceylon is reported to possess the largest ruby that was ever seen, being a span in length, and the thickness of a man's arm! brilliant beyond description, and without a single flaw." This was most likely *rubellite*, or red tourmaline.

A perfect ruby of large size is worth more than a similar diamond.

Blue sapphires occur of much larger size than the red ones. Sir Abram Hume possesses a crystal which is three inches long; and in Mr. Hope's collection of precious stones there is one crystal formerly belonging to the Jardin des Plantes of Paris, for which he gave £3,000.

The sapphire is usually found loose in the soil: primitive rocks, and especially gneissoid mica slate, talcose rock and granular limestone, appear to be its usual matrix. It is met with in several localities in the United States, but seldom sufficiently fine for a gem.

I must not omit to mention the huge ruby set in front of the Great Crown of England. It was presented to the Black Prince in 1367, and was afterwards worn by Henry V. in front of his helmet at the battle of Agincourt. In shape it is an irregular oval, pierced through the middle after the usual Indian fashion, and having this perforation filled up with a small stone of the same kind to conceal it.

The sapphire was seldom used for engraving on account of its hardness. Recently, however, a magnificent head of Jupiter, in the purest Greek style, was found ornamenting the pommel of a

Turkish dagger, the image-abhorring Moslem having turned the intaglio downwards, and faceted the back of the stone.

The Emerald and Beryl are varieties of the same mineral, and have a strong resemblance to each other, under the former name being comprehended the rich green transparent specimens, and those of other colours under the latter. Until very lately the colouring matter of the emerald was supposed to be due to the presence of one or two per cent. of oxide of *chromium*. This has, however, been proved to be incorrect by M. Lewy's recent chemical investigations into the formation and composition of the Emerald of Muzo. The quantity of chromic oxide obtained by analysis was so small as to be inappreciable, in fact too minute to be weighed separately; and the beautiful tint of the emerald is shown by M. Lewy to be produced by an organic substance, which he considers to be a carburet of hydrogen, similar to that called *chlorophylle*, which constitutes the colouring matter of the leaves of plants.

Besides the organic colouring matter, Mr. Lewy obtained from 1·6 to 2·15 of water, from which, in conjunction with the presence of fossil shells in the limestone in which they occur, he has come to the conclusion that emeralds have been formed in the 'wet' way, that is to say, that they have been deposited from a *chemical solution*.

As a precious stone the Emerald ranks next to the Ruby in value. It may be distinguished from all the other gems by its colour, a pure green, without any admixture of blue or yellow. The beryl was anciently held to be of equal worth with the emerald, but the vast supplies of modern times have rendered it, although a beautiful and lustrous stone, comparatively valueless. In the British Museum are two specimens from New Hampshire, weighing respectively 48 lbs. and 83 lbs.

The finest Beryls (aquamarine) come from Syberia, Hindoostan and Brazil. The most beautiful emeralds come from Grenada, where they occur in dolomite. A crystal from this locality, the largest known emerald, 2¼ inches long, and about 2 inches in diameter, is in the cabinet of the Duke of Devonshire. It weighs 8 ounces 18 dwts.; and though containing numerous flaws, and therefore but partially fit for jewellery, has been valued at 150 guineas. It was brought to England by Don Pedro, having been obtained from the mines at Muzo. A more splendid specimen but weighing only 6 ozs. is in the possession of Mr. Hope. It cost £500.

Necklaces of Emerald have been found at Herculaneum, and in the Etruscan tombs. Emeralds of less beauty but of larger size are found in Siberia. A specimen in the Royal collection at St. Petersburg measures 14½ inches in length and 12 inches in breadth, and weighs 16¾ lbs. Troy.

In the United States Beryls of enormous size have been obtained, but seldom transparent crystals. They occur in granite and gueiss. Emerald is one of the lighest and softest of the precious stones.

The name Topaz is derived from Topazos, a small Island in the Red Sea, where, it is said, the Romans used to collect them. The prevailing colour of the Topaz is yellow, sometimes pale, as in the Saxon variety, (which loses its colour by heat and which in that state, has been sold for a diamond;) sometimes saffron-yellow as in that from India; sometimes brownish yellow, reddish, and even pink. These last three tints are peculiar to the Topaz of the Brazils. Perfectly colourless topazes are found in the Brazils at Minas Novas, and in Siberia, in which latter place they also occur of a pale blue, slightly inclining to green. These latter become electric by heat, while those of Saxony acquire electricity by friction only. In the Brazils Topazes have been met with of an amethyst color; they are very rare. In proof of this I may mention that a Mr. Von der Müll of Vienna paid 1500 ducats for a single specimen of violet-blue colored topaz.

Topazes have been sometimes engraved. There is at Paris a fine head of Bacchus, cut on yellow topaz; also a white topaz of the Brazils, on which are engraved the portraits of Philip II. and Don Carlos: it formerly belonged to the King of Spain. In the collection of the Emperor of Russia there are many beautiful topazes. The coarse varieties of topaz are employed as a substitute for emery, in grinding and polishing hard substances.

Topaz is cut on a leaden wheel, and is polished on a copper wheel with rotten stone. It is usually cut in the form of the brilliant or table. The white and rose-red are most esteemed. It occurs in a certain mountain rock, denominated "*Topaz rock*," which is an aggregate of massive topaz, quartz and *schorl*, or black tourmaline, as it is now called. It also occurs in granite with beryl and rock crystal.

The accompanying diagram represents two crystals penetrating the quartz gangue.

It is worthy of remark that this mineral readily absorbs dust, and is liable to crack, particularly in the direction of its cleavage.

The amethyst is a purple or bluish-violet variety of *quartz-crystal*, often of great beauty. The colour is owing to a trace of oxide of manganese. This is an entirely distinct species from the true *Oriental Amethyst*, a most scarce and valuable variety of the precious corundum; being, in fact, a purple sapphire. This gem, from its rarity, is known to but few of the English lapidaries.

The common variety generally occurs in *geodes*, associated with layers of chalcedony, carnelian, flint, &c. There were two or three large masses of amethyst exhibited at the Provincial Industrial Exhibition, from Parrsboro'. The usual form of this mineral is that of a six-sided prism, terminated at both ends by a six-sided pyramid: the lateral planes being often deeply truncated.

The opal is confined to almost one locality only (Hungary). It is found chiefly in the porphyries, and is easily affected by damp. An opal ring should never be washed in warm or soapy water, as it is a mineral which owes its beauty to its flaws or fissures, and these would be filled up by the water. It appears for the same reason to better advantage on a dry than on a damp day.

In Mr. Beresford Hope's collection is an opal worth £1,000, the value of which defrayed a portion of the law expenses connected with the "Hope" collection. The opal contains about 90 per cent. of silica, and 10 per cent. of water; it is softer than quartz, and may be scratched by it, or with a good file. The smallest opal, if really beautiful, is generally worth £4 or £5, and when the stones are large, their price rises out of all proportion.

The finest opals exhibit a rich play of colours when held up to the light. The colours it displays are blue, green, yellow and red.

On account of its beauty and rarity, this mineral is worked by jewellers into ring stones, necklaces and other ornaments. It is cut into a convex form, or "*en cabochon*," as this form shows its colours to the greatest advantage. The cutting is done on a leaden wheel with tripoli and water.

It does not appear that the opal was ever much used for engraving on.

The opal is frequently minutely disseminated through the porphyry; and pieces of this kind, when cut and polished, are worked for ornamental articles, as snuff-boxes, &c. This is one of the few minerals whose name has remained unaltered from the earliest times.

The next stone I have to mention is the garnet. It occurs almost always in primitive rocks, most commonly in the form of the dodecahedron, as also in that of the trapezohedron.

The best garnets are from Ceylon and Greenland: the cinnamon stone, another variety, comes from Ceylon and Sweden.—The larger specimens are used as ring stones, and, after cutting and polishing, are set either *à jour*, or are provided with a foil. Jewellers, in order to heighten the colour and transparency of some garnets, form them into *doublets*, by attaching to the lower part of the stone a thin plate of silver; or hollow them underneath.

The smaller kinds are used for necklaces and bracelets. Many fine pieces of engraving have been executed on this mineral. In the National Museum in Paris, there are several beautiful engraved garnets, and among others a very fine head of Louis XIII.

The mode of occurrence of the turquoise (which is the last in my list), is described in the following manner by Major Macdonald, who presented a series of very interesting specimens of this mineral to the "Jermyn Street Museum":—

"In the year 1849, during my travels in Arabia in search of antiquities, I was led to examine a very lofty range of mountains composed of iron sandstone, many days journey in the desert; and whilst descending a mountain 6,000 feet high, by a deep and precipitate gorge, which in the winter served to carry off the water, I found a bed of gravel, where I perceived a great many small blue objects mixed with the other stones; and on collecting them I found they were turquoises of the finest colour and quality. On continuing my researches, through the entire range of mountains, I dicovered many valuable deposits of the same stones, some quite pure, like pebbles, and others in the matrix."

Turquoise is also brought from a mountainous district in Persia, where it occurs in veins that traverse the mountain in every direction.

The turquoise receives a fine polish and is highly esteemed as a gem. The *occidental* or *bone* turquoise, a much inferior and softer stone, consists of fossil teeth or bones, coloured with phosphate of iron. Green malachite is occasionally substituted for turquoise, but it can always be distinguished from the real gem by the difference of colour, as well as by its inferior hardness.

ART. IV. ON THE ANTIQUITY OF MAN IN AMERICA. BY WILLIAM GOSSIP.

Read February 8, *and March* 8, 1869.

THE PEOPLING OF AMERICA.

THE Continent of America is an immense area ranging from lat. 82° N. to lat. 56° S. and from long. 35° to long. 168° W. It is bounded N. by the Arctic Ocean, E. by the Atlantic Ocean, W. by the Pacific Ocean, and S. by the Southern Ocean, so called. Although designated a Continent from its vast extension on all sides, it is nevertheless surrounded by water, the nighest land being the north eastern extremity of Asia, from which it is separated by the Streights of Behring, lat. 66° N., in some places only 36 miles broad. South of Behring's Streights, in lat. 57° N. are the Aleutian Islands, stretching from the Peninsula of Alaska nearly to the Asian Continent, lat. 52° 53′ N.—one thousand miles. These, the Asian shore of the Streights of Behring, and the Aleutian Islands, are the nearest lands west and north on the Pacific side to the American Continent. East and North, separated from America by Baffin's Bay and Davis' Streights is Greenland, ranging from lat. 59° 49′ to 81° 29′ N., with a much greater unknown northern extension; and from long. 20° to 75° W., which again is a short distance west from Iceland, easy of reach from the Continent of Europe. It must be evident therefore, that had the science of navigation been as well known to the ancient world as it is to the modern, in either continent, there could be no physical reason why America should not have been systematically peopled from Europe or Asia by these routes, if all others were impracticable, or why there might not have been an intercommunication between them. Or, ignoring such ideas, why accident from imperfect navigation may not have cast human beings on the northern or other coasts of America, on both sides, who became the progenitors of the American Indians.

We are not, however, warranted by facts, in ascribing the peopling of America to either of these conjectural causes; although shadowy traditions have always been extant in the eastern hemisphere of lands beyond the flood, which it was impossible to reach, inhabited by rich and civilized communities. These may have had reference to inter-communication with America in the long past; or they may have been amplified fictions of the imagination. There is nothing tangible in these floating traditions or myths; and all real knowledge of a western continent had long been lost.

Modern research, however, has sufficiently proved, that early in the tenth century, before Columbus landed in America, the Northmen sailing west from Iceland discovered Greenland and planted Colonies; and from thence, still continuing west, came upon the coast of America, landed, wintered and formed a settlement.* It is conjectured that they may have touched at Labrador, or the Island of Newfoundland, skirted Nova Scotia, and proceeded farther south than New England. If they did so history is as oblivious of the results of their voyages as of those of earlier periods. They left no reliable record of their presence in a country much better than their own, which once found they ought never to have lost sight of. Little however could have been expected from the Icelandic navigators. The difficulties and hardships attendant upon the colonization of new countries, inhabited by hostile races, are well known even in modern times, and with all the appliances of civilization. They may have been so great then as to discourage the adventurers, and may plead an excuse for neglecting the discovery. Although believing that they did land upon this continent we are compelled to affirm that it proved valueless, alike to themselves and the imperfect civilization of their times; and that there is no reason whatever to suppose that they contributed a tribe to America, or influenced the lives of its people.

But, in whatever way the western continent may have been

* It continued to be known to them until the 12th Century.—*Pub. Roy. Soc. N. Antiqns, Copen.*

originally peopled, it is an indisputable fact, that from extreme north to farthest south, and throughout its entire breadth, it was inhabited long ages prior to the discovery of Columbus by numerous tribes of men, whose normal condition indicated that their advent must have been subsequent to the origin of the race in Asia, and ages anterior the period when an ancient civilization prevailed in the earliest of the eastern empires of which we have authentic record.

OPINIONS OF PHILOSOPHERS AND TRAVELLERS.

The attention of philosophers has long been directed to the problem which this wide peopling of the western hemisphere, so completely isolated from the eastern continent, has placed before them. The solution is not easy. It leads the ethnologist through the whole range of human progress and capacity back to the creation of man, and still it seems impossible to arrive at a definite conclusion. Probability and possibility—hypothesis and theory—are all that have yet been evolved from the investigation. Some of these are the speculations of infidels, others are grossly absurd, and almost all lack a large portion of the element of common sense.—It may not be amiss to refer to a few of them, collected from various sources and bearing upon the pre-Noachite antiquity of man in America. A variety of material is ready at hand for this purpose from the Smithsonian Papers, and other sources.—

1. Paracelsus suggested, and Lord Kaimes and others have argued upon general philosophical principles, that the races of men and animals were severally created in the regions which they inhabited.

2. Among authors who assume that America was peopled before the Noachian Deluge, Burnett, in a Theory of the Earth, published in London 1684, states the belief held by some, "that the earth, before the flood, was one mass of land, and when this was broken at the Deluge, Providence made provision to save a remnant of people in every country, although we have accounts of what happened in one continent only. It has been argued, from differences in the animal kingdom, many of whose species would not survive transportation, that they must have been originally bred where they are found; and it has been maintained that, according to

the prevailing traditions of antiquity, Paradise was without the eastern continent, and beyond the ocean."

3. Dr. Morton, an eminent physiologist and able writer, in his work "Enquiry into the distinctive characteristics of the aboriginal race of America," says "that the study of *physical conformation alone*, excludes every branch of the Caucasian race from any obvious participation in the peopling of this continent;" and again —"that the organic characters of the people themselves, through all the endless ramifications of tribes and nations, prove them to belong to one and the same race, and that this race is distinct from all others."

In one of his papers he observes, "I regard the American nations as the true *autochthones*—the primeval inhabitants of this vast continent, and when I speak of their being of one race and of one origin, I allude only to their *indigenous* relation to each other, as shown in all those attributes of mind and body which have been so amply illustrated by modern ethnography."

4. Messrs. Nott and Gliddon, in a book entitled "Types of Mankind," published in 1854, illustrated by selections from the unedited papers of Dr. Morton, and contributions from Prof. L. Agassiz and others, urge the following among other propositions :—

"There exists no data by which we can approximate the date of man's first appearance upon earth; and for aught we yet know it may be thousands of millions of years beyond our reach.

"The *human fossil remains* of Brazil and Florida, carry back the original population of this continent far beyond the necessity of hunting for American man's foreign origin through Asiatic emigration.

"There are natural relations between the different types of man, and the animals and plants inhabiting the same regions.

"Not a single animal, bird, reptile, fish, or plant, was common to the Old and New World."

5. Capt. Bernard Romans, who in 1771-2, travelled through the Carolinas, Georgia, E. and W. Florida, and as far west as the Mississippi river, says very little about ancient remains, but offers some decided views respecting the aborigines, and expresses his belief, that "from one end of America to the other, the red people are the same nation, and draw their origin from a different source

than either Europeans, Chinese, Negroes, Moors, or any other different species of the human genus." He further says, "I am firmly of opinion that God created an original man and woman in this part of the globe of a different species from any in other parts." p. 38.

6. Samuel F. Haven, in his "Archæology of the United States" published by the Smithsonian Institution, 1856, and with reference to Nott and Gliddon's "Types of Man," already noticed, but without giving an opinion, says:—"If we may judge from the tendency of recent publications, we must be prepared for the re-advancement of an ancient theory, now based upon geological phenomena, the structure of native dialects, and other scientific data, which would give the New World precedence of the Old one, as sooner prepared for the occupancy of human and brute creation, and as actually inhabited at a more remote period."

7. Bearing upon this view of the subject, Mr. R. Haliburton, a member of our own Institute, in an able paper, "On the Festival of the Dead," printed in the first No. of our Transactions, adduces a variety of facts connected with that celebration in November, and that of the primitive year as regulated by the Pleiades, which so far are confirmatory of the unity of the race. He considers it plainly manifest, that from Australia to Britain, we have all inherited these celebrations from a common source. He then asks a question—"Was it carried south by northern nations; or, has there been a migration of southern races to northern latitudes?" He begs the answer when further on he says:—"It is not gratifying it is true, for civilized and refined nations to trace their origin to the savages of the Pacific Islands; yet those persons who may dislike the conclusions to which this enquiry tends, may if they agree in the correctness of my views, console themselves by remembering the monuments of an extinct civilization that are still to be found in those Islands, and that must have been the work of races far superior to the present races of Polynesia." * He quotes Prof. Max Muller's opinion derived from a supposed similarity of structure of the Polynesian and Indo-European languages—as confirmatory of the conclusions to which ethnology had led him—to wit:

* Referring to the singular remains in the Easter Islands, that have attracted so much attention.—*Ellis Pol. Res.* viii, 325.

"that strange as it may sound to hear the language of Homer and Ennius spoken of as an offshoot of the Sandwich Islands, mere ridicule would be a very inappropriate and very inefficient answer to such a theory," and that "there are other theories not less startling than that which would make the Polynesian language the primitive language of mankind."

8. Colonel Galindo, late Governor of the Province of Peten, in Central America, in a paper on the ruins of Copan, communicated to the Hon. Thomas Winthrop, President of the American Antiquarian Society, Boston, dated at Copan, June 19, 1835, says: "The Indian human race of America I must assert to be the most ancient on the globe. However the white race, led by a foolish vanity, may assume to be the progenitor of the human family, it is probable that at a very recent epoch it has issued from the regions of the Caucasus, inundating Europe, extending itself over America, and with the energy of its youth and talent now invading Asia and Africa. The Indian race, on the contrary, has arrived at a decrepid old age; it has passed through the stages of youth, manhood and even decay." * * * He deems the Indian race predecessor in civilization of the Chinese, and even more than they in an old age incapable of regeneration, and goes on thus: "To the primeval civilization of America we must assign a great and indefinite antiquity; of course no palpable remains or monuments of that epoch now exist. Its destruction may be ascribed to some convulsion of the earth, to plague, to famine, to an invasion of barbarians, or perhaps to an insurrection of slaves; the colonies or remnants of these anciently enlightened people, *passing to the eastern coasts of Asia, commenced the civilization of Japan and China.*"

It may not be out of place here to quote an opinion of the celebrated traveller Humboldt.—

"The natives (of Peru) described to him that the name Chimborazo, meant simply "the snow of Chimbo," a name given to the district in which the mountain is situated: but he inclined to think that the name might be totally independent of the *Inca* language, and have come down from an earlier and forgotten age. He points out that the names of other mountains, such as Cotopaxi, Pictunea and Ilinissa, are totally devoid of meaning in the language of the

Incas, and conceives that the name Chimborazo, like these, may have been derived from some tongue whose memory has perished from the face of the earth."

OPINIONS CONTROVERTED.

These quotations as well as numerous others of a similar bearing that might have been made, cover what may be styled the objective theories to the unity of the human family; but no process of induction will establish as a fact the suggestions of Paracelsus, that the races of men and animals were severally created in the regions which they inhabited: or the "theory," published by Burnet, that Paradise was without the Eastern Continent; or the "*opinion*" of Morton—that the American nations are the true *autochthones*, having an *indigenous* relation to each other; or that of Nott and Gliddon, and Agassiz—that for aught we know the appearance of man upon earth may be millions of years beyond our reach,—that the human fossil remains of Brazil and Florida prove the original population of this continent prior to that of Asia,—that none of the animal species are identical;—or the strong opinion of Captain Bernard Romans—that God created an original man and woman in this part of the globe, of a different species from any in other parts; —or the half ventured opinion of Haliburton, that the refined and civilized nations of the Old World are descended from the savages, or the presumed ancient civilization of the Pacific Islands;—or that of Colonel Galindo—that to the primeval civilization of America we must assign an indefinite antiquity,—and that colonies from that antiquity commenced the civilization of Japan and China.

It is worthy of notice connected with the geological evidence of man's first appearance on the earth, that when any proposition is made which seems to invalidate the Scripture history, counter evidence is easily and readily produced, based upon scientific facts and deductions in accordance therewith. None of these philosophers, with the desire in their hearts to show that the human race is twenty, thirty, forty, or a hundred thousand years old, pretend that man appeared on the earth before the recent period, or when all things were much the same as they are now, except the changes wrought by convulsions of nature, subsidence or emergence in sundry places, volcanic action, earthquake, or flood. They find a prehistoric time in the existence of man in Europe and America, stretching back into eras of uncertain date and continuance. They find his bones and rude implements, along with or nigh to the bones of extinct animals, which there is good reason to believe were contemporary with him, and which in his migrations, with all the world before him, he may have hunted and eaten. They find these remains imbedded in alluvium, or peat, or limestone, under circumstances suggestive of ideas that they are coeval, although totally ignorant of the phenomena that may have brought them together; and they base a theory of time upon a suspicion of facts, which provokes discussion, leads to further research, and almost invariably produces counter evidence to upset or neutralize their speculations. The principles of the science of Geology are firmly established; but calculations of time during any of its successive periods are not to be relied on; and in the Recent especially, when made to account for the age of such loose materials as alluvium, or peat, or such easily compacted rocks as coral or limestone, or of their contained remains, must be generally doubtful, and often false and delusive.

The bold assertion of Messrs. Nott and Gliddon, that the fossil remains of Brazil and Florida carry back the original population of America beyond the necessity of hunting for American man's foreign origin through Asiatic emigration, is of the character above alluded to, and is met and reasonably disposed of by Sir Chas. Lyell, himself not free from a certain belief in the pre-adamite antiquity of man. He had called attention to the Brazilian human fossils in his travels in America in 1842, when he imagined, owing to the presence in the same matrix of oysters with serpulae attached, the whole to be of submarine origin. Subsequently he found reason to relinquish that idea, and did not doubt that the shells had been brought to the place and heaped up with other materials, at the time when the bodies were buried, and then supposed that "the whole artificial earthwork, with its shells and skeleton, might have been bound together by an infiltration of carbonate of lime, and that the mound might therefore be of no higher antiquity than some of those on the Ohio,—to which he alludes in substance as follows:

"The extraordinary number of the mounds implies a long period, during which a settled agricultural population had made considerable progress in civilization—so as to require temples for religious rites, and fortifications to protect them from their enemies. Some (the mounds) are so ancient that rivers have had time to encroach on the lower terrace which supports them, and having undermined and destroyed a part of the works, again to recede for the distance of nearly a mile."

The age of these mounds is approached by a quotation from a memoir on the subject by the late General Harrison, President of the United States in 1841. "We may be sure," he observes, "that no trees were allowed to grow so long as the earthworks were in use, and when they were forsaken the ground, like all newly cleared land in Ohio, would for a time be monopolized by one or two species of tree, such as the yellow locust and the black or white walnut. When the individuals which were the first to get possession of the ground had died out one after the other, they would in many cases, instead of being replaced by the same species, be succeeded by other kinds, till at last. after a great number of centuries, (several thousand years perhaps,) that remarkable diversity of species, characteristic of North America, would be established."

So then, if we allow two or three thousand years for the trees, (which I take to be far too long) and two thousand years for the progressive civilization of the mound builders, (which judging from the remains of that civilization is too long also,) there may still be good ground for believing (Messrs. Nott and Gliddon to the contrary) in the Asian migration to America of the human species, and in their descent from Adam.

In like manner may the age of the coral reefs of Florida, as calculated by Professor Agassiz, be disposed of. He estimates that it has taken 135,000 years to form the southern half of that peninsula, and based upon this calculation, that the age of a calcareous conglomerate, forming a part of those reefs, in which some fossil human remains have been found consisting of jaws and teeth, with some bones of the foot, is about ten thousand years old. Now you will recollect that our worthy President, (Mr. Jones,) in a Paper on the Corals of Bermuda, showed in a most conclusive manner, that some species of coral, instead of being of slow growth, were in the Bermudas at least, of very rapid growth; and he produced specimens of common wine bottles, which were completely encrusted with it, proving very simply, that it was possible for a large growth of coral to take place in a few years, and that therefore the estimate of ten thousand years as the age of the Florida human fossil, or a few bones found in dead coral debris thrown up by the ocean, must be entirely erroneous; and upon this point alone, without reference to any phenomena but the natural course of events, or considering other circumstances, these remains would come far within the chronologic era, whatever may be their true age.

Again, in this connection, I would shortly refer to the hypothesis framed on the similarity of certain periodic observances in the eastern and western hemispheres, in the mind of our friend Haliburton, and which has taken complete possession of other minds. I think that clear sighted as he is, and justly proud of his ethnological discovery, he yet goes a step too far when he imagines that the origin of man took place in the South Sea Islands, or perhaps in Australia; or that emigration from thence conveyed these observances to Asia, from whence they were propagated over the known world. Surely if it were so, these countries prolific of all that can minister to human progress, could not have fallen into an oblivion that left no traces of them, or into the extreme of human degradation. At the discovery of America, the Aztecs had succeeded to, and improved upon the civilization of the Toltecans,—yet Australia, and many of the Southern Islands, contained a population that might fairly be termed the fag end of humanity; with no evidence of a genius that could warrant a belief that they were the progenitors of Asian or European migrants. It would be far more within the range of probability to assume, that those observances and customs were inherited directly from Adam, degenerated by progressive and long continued migration from the common centre, which had also affected the primeval type of the race; and in the eastern hemisphere that they may have been derived directly from the Noachian family, who inherited them in common from Adam, and probably practiced them, but had no knowledge of the Southern hemisphere.

THE AMERICAN RACE PRE-NOACHITE.

While these and all other hypotheses and theories which imply that the American savage is predecessor to the civilized races of the eastern hemisphere, are incapable of being reduced to sufficient proof, and are therefore contrary to what we believe as an act of faith, they nevertheless all agree in one essential truth. They carry back beyond the remotest knowledge, and therefore beyond the Noachian family, the arrival of the human race on this Continent. Of that era we shall probably never possess more information than at present. From a people having no written language, and living upon tradition up to the time of Columbus, but little can be expected that will bear the test of authenticity. This is not surprising. It is a reiteration of what we know of the ancient inhabitants of Europe two thousand years ago, and of our own British ancestry. But in all this there is nothing to disprove the unity of mankind; and we may therefore fairly leave their history in America, as God has left it, to be defended by natural phenomena, and a faithful and reasonable interpretation of the divine record.

From my own point of view, and for the further elucidation of my argument, it is very important that the high antiquity of the American race should be fairly established and conceded. I have shown that geologists and ethnologists are alike agreed upon the subject—although in most instances with great exaggeration. I shall notice further another series of proofs, based upon a similarity of construction in all, with scarce a single exception, of the primitive languages of this continent.

EVIDENCE DERIVED FROM THE CONSTRUCTION OF LANGUAGE.

The Hon. Albert Gallatin, an American Secretary of State, and a learned and judicious writer, who had all the information of his department relative to the Indian tribes at his disposal, communicated to the American Antiquarian Society in 1836, by whom it was published, "A Synopsis of the Indian tribes within the United States east of the Rocky Mountains, and in the British and Russian Possessions of North America." He ascertained the languages of eighty-one tribes, and investigating the several dialects and vocabularies, divided them into twenty-eight families, and of these he says, "I feel some confidence that I have not been deceived by false etymologies, and that the errors which may be discovered by further researches, will be found to consist in having considered as distinct families, some which belong to the same stock, and not in having arranged as belonging to the same family, any radically distinct languages forming separate families." He uses the term "families" not in a limited sense, but in the same way as we consider the Slavonic, the Teutonic, the Latin and Greek and Sanscrit, and the Zend or ancient Persian, as retaining in their vocabularies conclusive proofs of their having originally sprung from the same stock. The conclusions he arrives at are that "the number of families of distinct languages, and of dialects, does not appear to be greater in North America than is found amongst uncivilized nations in other quarters of the globe, or than might have been expected to grow out of the necessity for nations in the hunter state to separate and gradually to form independent communities." He can perceive nothing in the number of the American languages, and in the great differences between them, inconsistent with the Mosaic chronology. And further on—"the similarity of their structure and grammatical forms, has been observed and pointed out by the American philologists, the result being confirmatory of the opinions on the subject, of Mr. Du Ponceau, Mr. Pickering and others; and as proving that all the languages not only of our own Indians, but of the native inhabitants of America from the Arctic Ocean to Cape Horn, have as far as they have been investigated, a distinct character, common to all, and apparently differing from any of those of the other continents with which we are most familiar."

Mr. Gallatin does not assert that there may not be some American languages differing in their structure from those already known, or that a similarity of character may not be discovered between the grammatical forms of the languages of America, and those of some of the languages of the other hemisphere; but he says, "the materials already collected appear to justify the general inference of a similar character;" and further on—the languages "of America seem to me to bear the impress of primitive languages, to have assumed their form from natural causes, and to afford no proof of their being derived from a nation in a more advanced state of civilization than our Indians. Whilst the unity of structure and of grammatical forms prove a common origin, it may be inferred from this, combined with the great diversity and entire difference in the words of the several languages of America, that this continent received its first inhabitants at a very remote epoch, probably not much posterior to that of the dispersion of mankind; and it deserves notice that the great philologist Vater, could point out but two languages that, on account of the multiplicity of their forms, had a character if not similar at least analogous to those of America." These were the Congo and the Basque. The first is spoken by a barbarous nation of Africa. The other is now universally admitted to be a remarkable relic of a most ancient and primitive language, the ancient Iberian, formed in the most early ages of the world. *

The peculiar characteristics of the American languages, are shortly described in a report of the Historical Committee of the American Philological Society, published in 1819—"We find" the report states, "a *new*† manner of compounding words from various roots, so as to strike the mind at once with a whole mass of ideas; a *new* manner of expressing the cases of substantives by inflecting the verbs that govern them; a *new* number (the particular plural), applied to the declension of nouns and conjugation of verbs; a *new* concordance in tense of the conjunction with the verb; we see not only pronouns, as in the Hebrew and some other languages, but adjectives, conjunctions and adverbs, combined with the principal part of speech, and producing an immense variety of verbal forms. When we consider these and many other singularities, which so eminently characterise the American idioms, we naturally ask ourselves the question; Are languages formed on this model to be found in any other part of the earth?"

Now this facility of compounding words, and of combining with the principal part of speech, pronouns, adjectives conjunctions and adverbs, when once mastered, seems to explain why the American languages are so much more numerous than those of other continents, because it would be very easy to invent additions to the roots to suit all ideas, as circumstances might arise, which amongst

* It is observed by Vater also—that "the discrepancy in the American languages extends to words or notes only, the general internal or grammatical structure being the same for all."

† New to them, but very old in point of time.

wandering tribes would soon transform a dialect. If we take therefore the calculation of the celebrated Adelung, that the number of American languages and dialects amounts to 1264, which is nearly double those of Asia and Africa together, the preponderance might probably result from the before mentioned cause. Still the element of time may be necessary if we desire to arrive at a fair conclusion where the number of languages is so large by comparison. If we assume that it has taken the period since the Flood to accumulate the languages and dialects of Africa and Asia, we may have to admit the *probability* of a much longer period, to account satisfactorily for the larger number of languages and dialects in America, and therefore of the higher antiquity of the race.

To every believer in the Mosaic chronology and narrative of events, it will appear indisputable that the sons of Noah and their immediate descendants spake the language, or a dialect of the language, of the Adamic race before the Flood. However long it may have taken after this last event to arrive at the plain of Shinar, (the site of which is questioned at the present day,) and however they may have multiplied in the meanwhile, that narrative informs us, that then "the whole earth (i. e. that race of men,) was of one language and one speech." With such a simple fact as this, I am puzzled to account for the anxious search of philologists after a language they call the Aryan, from which to prove the derivation of all known languages. It was undoubtedly that spoken by the Adamic family previous to the Deluge, and by the Noachian family immediately after it. There may have been several dialects amongst the antediluvians. But it is quite evident that the Shinar language was that of Noah, the only question being as to what was at that epoch the extent of the refinement of language. When the dispersion took place, that is, when the Lord visited them, the unity which previously existed was dissolved or broken by pestilence, or strife, or jealousies, which caused the various tribes and families to separate in every direction, with all the eastern world before them. From these separations sprang numerous dialects, which as intercommunication ceased soon changed into distinct languages, which as civilization and refinement prevailed became polished and artistic, retaining little or nothing of the original structure; and in the course of ages, when writing was invented and letters cultivated, dispensing with it altogether.

For the structure of this purely original language of mankind, (a gift of the Creator,) we must look to a period long anterior to Noah. There is some reason for the belief that philology had become a science among the antediluvians. The human race when the Flood came was 1600 years old, and must have advanced in art and science. It is significant of considerable progress in language, that Noah was himself "a preacher of righteousness;" and in the arts, that he could have constructed such a piece of naval architecture as the ark. The fact also, that polished languages, like the Zend or ancient Persian, and the Sanscrit, both of which still retain remote affinities with previous structures—to say nothing of the Chinese, the Egyptian, the Chaldaic, or the Hebrew—were in use at an early period after the Noachian deluge, would seem to prove that they all received their impulse from the philological attainments of Noah's family.

If then we have to look for the original language of mankind, nearer to the creation than the date of the deluge, we may infer that the people who reached America between those epochs, brought it with them. There may have been several arrivals. They were hunters, and have so continued, separating from each other, multiplying dialects, eschewing civilization and civilizing influences, never having attained to the art of representing their ideas by arbitrary characters, and consequently never losing the original structure of language. They were the true Aryans. When it is asserted that there are only two known languages of the eastern hemisphere, possessing a character analogous to those of America, the proper enquiry should be, not whether the languages of America are derived, but the reverse. If the various aboriginal dialects, so similar in their structure and grammatical forms, could be resolved into their roots, we should probably find the basal language, the Adamic, as distinguished from that spoken by Noah and his immediate offspring. Even now the Indian dialects must approach the former more nearly than any other language on the face of the earth. Nor do I deem it presumptuous to say, that in the sweet musical tones of the languages of the aborigines of America, (one of which we may hear almost daily,*) we approach as

* The Souriquois or Micmac, spoken by the Indians of Nova Scotia.

nigh as possible to the language in which Adam conversed with his Almighty Maker in Paradise.*

The examples quoted are sufficiently clear as regards the opinions of able men who have carefully investigated the subject, that the human race in America were not known to Noah or to his descendants; but are derived from ancestors who arrived at a time so remote that all trace of it has vanished, not only from history but from tradition. It is equally plain from all the evidence of colour, religion, occupation and language, that they were the primitive people,—that for long ages they continued isolated, and grew numerous and spread over the continent, still preserving their distinctive unity. If there ever were chance arrivals from the eastern

*When this paper was read I had not seen Principal Dawson's second edition of Acadian Geology. There is in that work an excellent chapter (IV.) on prehistoric man, which accords generally, but more at length, with the short notice of the Souriquois (Micmac) tribe of Indians, which I have given further on. The "Appendix" contains also, under the letter "A—Micmac Language and Superstitions," some very interesting observations and examples, for which Dr. Dawson is indebted to Rev. Mr. Rand, referring to strong points of resemblance between the Micmac and Maliseet languages and some of the older languages of Europe, which may still be traced in many root words. These points of resemblance are certainly very striking. Dr. Dawson says "They are undoubtedly too numerous and important to be purely accidental; though they may be accounted for by supposing that the Algonquin languages, (of which the Micmac is a dialect,) actually retain traces of roots derived from the Eastern Continent; or by supposing that in the formation of the language similar ideas as to onomatopœia occurred to the mind of the American Indian and his contemporaries in the Old World."

The tenor of Dr. Dawson's observations proves that he is as much hampered by the Noachian Deluge, as any of his predecessors who have written upon the subject. Most of the words compared have the same sound and signification in the Micmac dialect and Greek language. But it is hardly possible that the Greeks, who in the days of Homer and for ages previously, had made so little improvement in the science of navigation, and who rarely ventured out of the Mediterranean at any subsequent period of their ancient history, could have passed to America, either to colonise, or by accident. The same may be affirmed but with less reason of the Hebrews. Some other solution must be found to account for the resemblance; and I think a much more satisfactory one is that which I have given. If the Greek, Hebrew and cognate languages, as well as those of more ancient date, manifest a similarity in the form and meaning of certain words, and also, but much less striking, in some principles of construction to the Micmac, would it not be much more reasonable, seeing these are now few, to derive them from a language spoken in the old world some eight hundred years before the Noachian Deluge, when the ancestors of the Micmacs may have been wending their way to this continent. I believe it will be found that the nearer the ancient languages approach in time to that event, the greater will be the general similarity to the languages of America, allowance being made for the advancement as regards the former, in philological science; and with reference to coeval ideas of "onomatopœia," we may suppose that the human mind, separated in the body by immense distances, may have (and I believe has) produced architectural forms very much alike; but it is inconceivable that congruent ideas, should produce the same sounds, or forms of speech so much alike.

The Algonquin is the most numerous, widest spread, and probably the most ancient of all the northern families of Indians.

hemisphere, they must have been at a much later period in the history of mankind, and were not sufficient to influence the dominant characteristics. They may have taken place, and helped to modify some of these to such an extent as to give a new turn to the aboriginal mind, and lead onward to that civilization which was apparent in Mexico, Central America, and Peru, when the bigotted Spaniard came upon the scene.

TRADITIONARY AND GEOLOGICAL EVIDENCE.

Although positive proof does not exist, there is a probability, based upon traditionary and geological evidence, that since the advent of man there has been a continuity of land between the eastern and western hemispheres. Many circumstances favour the supposition, which has been countenanced in ancient and modern times.

It is recorded by Plato, that an Egyptian priest related to Solon, (then a traveller in Egypt, about 600 years before our era,) "that in one of the numerous deluges that had taken place, the great island of Atlantis, larger than Lybia and Asia together, was submerged in the ocean that bears its name. The Island was stated to be opposite the Straits of Gades, (Gibraltar.) Allusions to this lost island or continent are frequent in Greek and Roman writers; and modern authors are quoted as believing in its reality. According to Plato there were first smaller islands, from which there was an easy passage to the larger one or continent beyond. It is supposed by many that this Atlantis was America."

The geological evidence of the probable existence of continuous land is supported by facts and inferences derived from the science. I have already stated that it would be easy now to make the passage from Europe, or from Asia to America, by the Atlantic and Pacific Oceans. There is no record that it was ever made in ancient times, since the continents and islands have assumed their present shape and proximity. They have not, however, always maintained these relative positions. Great changes have undoubtedly taken place, in the eastern hemisphere especially, since the advent of man—so vast indeed that we can only satisfactorily account for the long and complete isolation of America, and the peculiar character of its fauna and of the human family within its limits, by supposing that the cataclysm that left the Noachian family to repeople the eastern world must have effectually divided it from this continent, except at points where there was no likelihood for long ages of intercourse with its people, or its animal life of any species or variety.* This is perfectly in consonance with what I take the liberty to style the intrinsic truth of the Mosaic history.

Sir John Herschel, in a work on Physical Geography, published 1861, when speaking of the open sea which is caused in part of the polar regions by the escape of ice through Behring's Streights, observes that these Streights, by which the continents of Asia and North America are now parted, "are only thirty miles broad where narrowest, and only twenty-five fathoms in their greatest depth. But this narrow channel," he adds, "is yet important in the economy of nature, inasmuch as it allows a portion of the circulating water from a warmer region to find its way into the polar basin, aiding thereby not only to mitigate the extreme rigour of the polar cold, but to prevent in all probability a continual accretion of ice, which else might rise to a mountainous height."

Dana in his excellent Manual of Geology, treating of the geographical distribution of volcanoes, a cause or effect of disturbances of strata, observes,—"In the Aleutian Islands, which form a curve like a festoon across the northern Pacific, there are 21 islands with volcanoes; in Kamtschatka, 15 to 20; in the Kuriles 13; in the Japan group 24."

Facts seem to indicate that Behring's Streights may not have existed in the early centuries of the history of man. The volcanic Aleutian Islands, stretching across the ocean at no great distance south from them, if they represent the summits of submerged lands, as may reasonably be believed, would indicate a vast area of subsidence in which they may have been prominent agents, and which may have affected the whole region, extending northwardly to and beyond the Streights. Colonel Charles Hamilton Smith, in his work on the Natural History of the Human Species, which is often quoted as good authority, observes of Behring's Streights,—"As the water with several shoals, is flooded with fossil bones and shells, and there being no river of importance on either shore of the continents, or near on the arctic side, no great pressure can have come from the polar ocean; and consequently, no great opening if any,

* These are very similar at the points of nearest approach.

until the arctic rising of Asia and Europe altered the relative conditions of the two seas. That once there was no current, may be inferred from the islands of New Siberia (northwest of the Streights) being in part composed of ice mixed with mammoth bones, tusks and other organic remains; and the presence of several species of land mammals common to both continents, attests a facility of passing from one to another." These fossil bones and other recent organisms, show that the animals to which they belonged inhabited the country and roamed over it; and that therefore the climate must have been very much milder than it is now, and the vegetation luxuriant. This would be the case undoubtedly, if the land were once as elevated as is Mount St. Elias, south of the peninsula of Alaska. A range of high lands, spreading such a distance, cutting off communication with the frigid ocean, and swept at their base by the warm currents of the Pacific shores of America and Asia, would have had a temperature in the valleys in this latitude as high as that of the Japan Islands; and there would have been no obstacle to the passage to America of any portion of the race of Adam which might have made progress in this direction. This condition of the arctic regions granted, there need be no question now as to the colour, or physiognomy, or craniology of the human beings who first arrived in America, or the country from which they migrated. Nor if there be good grounds for supposing such a catastrophe as I have assumed for the arctic borders of the continents, which may have taken place contemporaneously with the Noachian deluge, or anterior or subsequently in the history of mankind, there can be nothing strange in the diluvial tradition common among all the American tribes. It may be referred to such an event, or one very distinct from that in which Noah and his family were preserved.

It does not appear that the American coast of the Pacific south of the Aleutians, partook of the depression which has so affected the Asian side. South of these islands is Mount St. Elias, 17,500 feet high; and no such disturbance within human chronology has affected the Rocky Mountains or the Andes, nowhere at a great distance from the Pacific.

Supposing then that the catastrophe which submerged the arctic lands,—and which may have involved the sea of Kamtschatka, the Kurile islands, the sea of Japan and even the Yellow Sea, all great basins of depression on the Asian side of the Pacific, festooned by curves of volcanic islands,—was rapidly progressive, and that they have never recovered their former elevation, we shall be compelled to assume a change of climate, the destruction of a vast number of species, and the complete isolation of all the rest from either continent for the last five or six thousand years; and if we may further assume, that at this early period only man and comparatively few recent species had reached the American continent, the fact may be accounted for why species are less numerous upon it than in the old world; while a reason is afforded, not however conclusive, why the fauna of America is dissimilar to that of Europe and Asia, where there has been no isolation whatever.

When we call Geology to our aid to account for the northern continuity of land joining the continents, we shall find reason to believe that the facilities in the earliest periods must have been far greater than has yet been described, of reaching America by what I may call the middle, or southern passage. Dana, whom I have before quoted, instances the coral islands of the Pacific as affording proofs of great secular subsidence in that ocean. He divides by a line between Pitcairn's Island and the Pelew Islands, the coral islands from those not coral. Over the area north of it to the Hawaian islands all the islands are atolls,* excepting the Marquesas and three or four of the Carolines. If the atolls are registers of subsidence, (as is believed,) a vast area has partaken of it measuring 6000 miles in length, (a fourth of the earth's circumference,) and 1000 to 2000 in breadth. Just south of the line there are extensive coral reefs; north of it the atolls are large, but they diminish toward the equator, and disappear mostly north of it. The amount of this subsidence may be inferred from the soundings near some of the Islands, to be at least 3000 feet. But as two hundred islands have disappeared, and it is probable that some among them were at least as high as the average of existing high islands, the whole subsidence cannot be less than 6000 feet. It is probable that this sinking began in the post tertiary period.

This subsidence, which has now ceased, as is proved by the wooded condition of the islands, must have materially increased the distance between them, which was probably much less at the date

* Sunken Islands fringed by coral reefs.

of man's creation, and for a thousand years later, than it is now.* Consequently there were greater facilities of transit, and more resting places for a progressive emigration from one continent to the other. Supposing it possible that the route would have been taken (it may have been by accident) which is indicated in the distances between the Islands, there would have been the same facilities for repassing. But although the facts stated may account for a progressive emigration from Asia some centuries after the Creation, which may have reached this continent and impressed upon the central portions of it the germs of civilization, it is not at all probable that they point to the peopling of the Pacific Islands, until a period subsequent to the Noachian Deluge.

EVIDENCE OF COLOUR AND FEATURES OF THE AMERICAN RACE.

It accords with my theory, and consists with my belief, that the name *Adam*, given to the man in the day that he was created, betokened the colour of the individual as well as the material out of which he was made. That colour being red would not have been lost in his descendants, in the generations that elapsed between his creation and the date of the Noachian deluge. If transmitted therefore with those of them who arrived before the last event upon this continent, as it certainly must have been, we have probably, the original type of man, and also his colour before us, in the pure

* In considering the geologic phenomena that may have affected the peopling of America we must not lose sight of the Pacific Islands, which stretch between the two continents within twenty-five degrees north and south of the equator. The existing facilities of communication that are now afforded are thus described by a modern author. "Looking specially at the map the distance between the different groups of islands seems immense; but between these are smaller solitary islands, which materially diminish the distance to be traversed in order to pass from one to another. Suppose that the progenitors of the islanders (Polynesians) had started from the Malay coast or Sumatra, what would have been their route? By sailing 5 degrees or 300 miles they would reach Borneo; then by crossing the Straits of Macassar about two hundred miles wide, they would arrive at the Celebes, eight degrees from New Guinea; but the large islands of Bessey and Ceram intervene. The distance from New Guinea to the New Hebrides is 1200 miles, but the islands between them are so numerous that the voyage may be made by short and easy stages. Five hundred miles from the New Hebrides are the Figis; and about 300 miles further on the Friendly Islands; another stage of 500 miles brings you to the Navigators; but between these two points three other groups intervene. From the Navigators to the Hervey islands the distance is about 700 miles, and from thence to the Society group about 400 more. The western coast of South America is not very remote from the easternmost island of Polynesia, (near 2000 miles, however,) called Easter Isle, from which it may be reached in a few days sailing, with several islands or resting places between them.—*Miss'ny Enterprise S. Sea Islands, by Rev. J. Williams, &c.*

American Indian. That colour is modified in the high northern latitudes, and is gradually heightened as it approaches Central America, where the warm climate acts as it does upon the races of the temperate zone of the eastern hemisphere, after permanent residence for successive generations in the torrid zone—by deepening the tints. Nor is the red colour lost in the descendants of the family of Noah. We find it occasionally very vivid. I have seen it much redder in Europeans, especially in the Celtic family, than I have ever seen it in the Indian—in whom it approaches more nearly the Mongol red than the European. When in this last it comes out strong, it is a ruddy brick red, such indeed as is the consequence of a habit long continued of drinking ardent spirits. I do not mean, however, to connect the colour with that vice. It is in many instances natural. Among the Celts of this Province, whenever an individual shows it strongly, and it is desired to distinguish him from others of the same clan or surname, the Gaelic word *roy* which means red, is appended to his name, and he becomes Rory McKenzie, *roy*, or as the name may be. This much for red being the natural colour of mankind. The white man, by which name the civilized native of the temperate zones is distinguished among the dark races, has a colour which seems to be entirely a modification of climate, by which after long ages he has changed to a pink and white variety, a mixed colour, with occasionally a return to the original type too plain to be mistaken. It is a singular fact connected with this enquiry, that all the animals subjected by civilized man, vary in colour; while each species of the *feræ naturæ* preserve a striking uniformity.

It ought not therefore to be considered remarkable, that the Indian races maintain their uniform colour throughout the continent, although it may admit of question if they have done so entirely. A similarity of occupation, a generally unsettled life, pursuits which could not fail to turn the colour even of Europeans, the absence of civilization and sedentary occupations, all operate to prevent a change while they continue. That these causes have continued, and without interruption, through all their history, is tolerably evident, notwithstanding the remains of extinct races that exist, who may for a time have risen superior to the wild tribes around them. Where there had been any approach to settled life among the families of the caciques, or among the ruling families of Mexico, or the Incas of Peru, history informs us, that living in luxurious ease and refinement, they were as delicate and fair as Europeans. It may well be believed that they were much fairer than the Moor-tinted Spaniard who invaded them, and destroyed, or did his best to destroy a noble race.

OPINIONS ON IDENTITY OF RACES CONSIDERED.

Dr. Pickering, an American author of deservedly high repute, in a work entitled "The races of men and their geographical distribution," satisfied *himself* that the Californians, Mexicans and West Indians were *Malay Americans*, that is, owed their derivation to the Malay stock. The only mark by which he could distinguish between native Polynesians and half civilized Californians at the Bay of San Francisco, was that the hair of the former waved and inclined to curl, while the latter was invariably straight. He says, "the Californians do not scalp their enemies, nor use the tomahawk." All the other American races he classes as Mongolian. His observations appear to me to stop far short of the truth. Indeed they unwittingly point to the migration of the Malay race long subsequent to the occupation of the continent by a *more primitive race*, neither Malay nor Mongolian, although allied by descent, and which may be styled pre-Noachite. In ascribing to the Indian population a Malay or Mongolian affinity he is completely puzzled by contradictory circumstances, all which would have been reconciled had he admitted a pre-Noachite migration to America. Thus, he says—"The presence of two aboriginal races in America (Mongolian and Malayan) recalls certain historical coincidences. The Toltecs, the predecessors of the Aztecs in Mexico, were acquainted with agriculture and manufactures. Now such cultivation could not have been derived from the *Northern Mongolian* population, who in their parent countries, were by climate prevented from becoming agriculturists. If then the art was introduced at all *from abroad*, it must have come by a southern route, and to all appearance through the Malay race. This is not incompatible with an ancient tradition, attributing "the origin of their civilization to a man having a long beard;" *he* could not have been *Mongolian;* he *might have been* a Malay. If, however, *any* *actual remnant of the Malay race** existed in the eastern part of North America, it is probably to be looked for among the Chippewas,† and the Cherokees,"— where certainly the arts of cultivation had never been extensively practised, and where he will look a long time in vain for satisfactory confirmation of his "probability."

If I did not believe that this continent was first inhabited by the Adamic family proper, I might be inclined to accept the conclusions of Dr. Pickering, as to the origin of man in America. There is a general but accidental similarity of feature between our northern aborigines, (in whom however it is so much more noble in aspect, as to suggest at the same time a palpable distinction,) and the Mongol and Malay races. I say *accidental*, but it is not entirely so. It is what my theory would lead any one to expect. If the Adamic origin is represented in a race of Noachite descent—and the Mongolian is one of the most ancient as well as the purest of the post-diluvian stocks of men—it would be a reasonable inference that this most ancient and pure stock, should have a striking resemblance to a more primitive stock, separated from and preceding it by a good many centuries—both being modified to a similar tone of colour and expression of feature by climate very much alike; and nearly the same may be said of the Malay race. Some who hear me will, I dare say, recollect the Japanese troupe, recently in Halifax. I went to see them to get some instruction in the physiognomy of races, and to a certain extent obtained it. There was the "maker of celestial music"‡—he was an obese and apparently good natured and cunning fellow, with the brains to invent the speculation in which he was engaged, and the wisdom to profit by it. He had a head, the form of which would answer to any nationality whose costume he might assume—a true cosmopolite structure. The features of a distinct race were in him merged in an intermixture of races. The next was a "top spinner," a very amusing fellow, who had wasted a good deal of innate genius in a worthless occupation, which, wisely directed, might have made him

* The Italics are mine.—W. G.

† Gallatin says they did not practice cultivation.

‡ So styled in the bills—the "celestial music" being a kind of guitar which produced sounds of a tin-kettle character, but kept up a time to which the acrobat accommodated his motions.

a more useful if not a better man. So far as appearance went, he might be a compound of the various races which have made up the empire of Japan, the *ancient type* predominant. But there were two boys, very respectable acrobats and tumblers, who performed some amusing if not amazing feats. One of them impressed you very forcibly as being an immediate offspring of "celestial music," who took it so easy himself, but nevertheless made young hopeful do his work; and he did it with commendable agility. The other in appearance might have been the son of an Indian of the purest blood, and no one would have questioned his origin. This young fellow was of the genuine Indian colour—had the genuine Indian features, broad face, prominent cheek bones, black eyes with little or no obliquity, Indian nose, and coarse jet black hair, which escaped under a band tied round the head,—and was every whit in appearance more of a Micmac than a Japanese, if the others were good specimens of that stock. Had that boy approached me on our streets, I should have expected the juvenile Indian salute—"Giv' me a cent," and should not have been suspicious of his origin, had he turned a somersault in requital of the obligation, although wondering how he became possessed of that faculty. The Japanese are a very old race, an unique race, although mixed perhaps in the infancy of the empire, and since; and like the Egyptians and Chinese, had shut themselves in from the rest of the world, until in turn this course of proceeding had so impaired their knowledge of what was going on without, and with this their aggresssive energies, that they were not able to withstand the vigorous pressure of nations of more expansive intellect. The circumscribed Japanese, more than the Chinese, whose extensive empire and differing climates, are of themselves sufficient to modify, and have modified colour, language and dialects, have preserved affinities with the American or Adamic stock; and thus, I take it, that occasionally, or more or less, the distinctive features of each are perceived in the other, although the Japanese undoubtedly belong to the Noachian family.

Although in the progress of the migration east and north a few families or tribes, under the peculiar geological condition of the earth at the period, may easily have reached this continent, it does not follow that they brought along with them any of the elements of civilization. We may well believe that their journey could neither have been direct nor speedy. They were probably hunting offshoots from the primeval stock, as all offshoots at first must have been, wandering further and further from the common centre, never turning back, which it is not in the instincts of the emigrating portion of mankind ever to do, either wild or civilized, and having many resting places before they reached a country where their wants were abundantly supplied. They must, however, have brought with them the nearest approach to the Adamic worship of God, as well as to the language. The various distinct families now found in North America, may represent faithfully the ancestry of each; or separations or amalgamations at intervals, and extinctions, may have taken place, which increased or reduced their original number. There will be nothing incredible in this to all who believe that the *eastern* hemisphere, with its mingled nationalities, tribes, languages and dialects, was peopled by the descendants of Noah. Believing that ere they had reached the country now the Aleutian islands, they had already lost all knowledge of their origin, except what was traditionary, which vaguely appears in some of the legends of the oldest tribes, we need not wonder as ages rolled on, at their ignorance of their past history, which they only showed in common with the people who came after Noah. They could have known nothing of the cultivation of the soil, either of the art or its appliances, and needed not to know, in the abundance of animal life that on all hands administered to their necessities and their comforts. But of that happy time when this continent had but few human inhabitants, when peace prevailed in their tribes, and plenty in their wigwams, and the chase was occupation and pleasure and subsistence, the remembrance has been indelibly impressed on the Indian mind to the latest generation, and forms an essential feature of his creed. That he may attain to it is his chief incentive to a good life. It is to him a material heaven; and he has buried with him every implement which may be of use when he arrives at the happy hunting grounds in the land of spirits, where united with those he loved in life, and with those who had gone before, they may together enjoy for ever the pleasure and excitement of the chase.

EVIDENCE OF CULTIVATION OF THE SOIL.

It is probable that cultivation never originated from necessity. The contrary opinion has been held, but it is hardly tenable. Man naturally does not look to the soil for subsistence. It is a forcible argument in favour of the peopling of this continent from the North, that all its cultivation must have proceeded from the South, that is, from the central regions of America, where most likely it originated. In his primitive state, in most temperate and in all frigid climates, where vegetation is annually destroyed, man would never think of it, or the attempt would seem hopeless, and he would content himself with such cereals and esculents and fruits, as nature provided in her genial seasons. The difficulties in subduing the soil and husbanding its productions, would be much greater than in subduing the wild animals which roamed over it. He could never have conceived, without example, of a system of tillage, by which the ground was to be prepared for the seed, and the harvest gathered and secured for future use. In Northern America he found the wild animals a pre-existent creation, in a climate congenial to their nature, and multiplied exceedingly, as though awaiting his inroads. We shall not therefore be warranted in asserting that husbandry was the normal condition of the American portion of mankind. Indeed the contrary is typified in the sacred volume, where it is said that "unto Adam and his wife did the Lord God make coats of skins, and clothed them." Agriculture most likely originated in climates of equable temperature, where the productions of the soil intermitted and in some degree superseded the necessity for the labours of the chase. It would be first learnt, and its benefits perceived, when migration stopped at a region where the earth brought forth spontaneously the products that not only sustained life but administered to luxury. In a country like Egypt, for instance, where the annual inundation fertilized the soil, and seasons presented no obstacle to a continuation of crops, man would soon become acquainted with its rudiments. Placed thus by nature beyond the fear of want, he would roam no further; and in a settled life would soon discover the causes of fertility, and how to improve them to the utmost extent of affording sustenance to large communities. In process of time the knowledge thus gained would be communicated to other countries not so favoured. In Mexico and Central

America, more perhaps than in Egypt, just such a spontaneous fertility existed; and just such causes gathered the first wanderers of the North into this favoured region, where they became stationary and attained to a remarkable degree of civilization and refinement, manifested in their architectural remains. This civilization was never entirely lost, although its empire may have been destroyed by irruptions of barbarian tribes from the North; but was of itself sufficiently strong to absorb the conquerors, and even to change their habits and modes of life. The analogy is nearly perfect, without at all assuming that they knew each other, between the progress of the Adamic civilization in America, and that of the family of Noah in the eastern hemisphere, in the earliest portion of the world's history with which we are acquainted.

Cultivation, in any portion of this continent north of the equator, does not appear to have ever been extensive or varied. The Mexicans had attained to some proficiency in the art, and it was practised rudely by the tribes who inhabited east and west of the Mississippi. The labour in most instances was performed by women. Maize, of which it has been said, that it is not indigenous in America—that it may have been brought to this continent from the West India islands—and also that it is an Asian cereal, —was the chief article grown as food. Nor is *this* to be asserted without qualification. Catlin, in his description of the Festival which the Mandans held at their corn harvest, says,—that they wasted in a few days the product of a whole year. It may therefore have been looked upon among the tribes high up on both banks of the Mississippi, who depended more entirely on the chase, as a luxury of a short continuance, with which to diversify at a particular season the glut of animal food. Some esculents and roots, beans, pumpkins, sweet potatoes, water melons, and tobacco, in addition to the maize, were all the vegetable productions with which they were acquainted. It has however been satisfactorily ascertained, that the tribes toward the south depended more upon the cultivation of the soil than the northern Indians, and less on hunting, an evidence of the gradual extinction of wild animals, and the natural progress towards civilization. When De Soto explored the country from Mexico to the Mississippi the Spaniards were fed almost exclusively on maize, and complained of the want of meat. Two hundred years later, Bernard Romans, whom I have before quoted, says, "that near half of the Choctaws had never killed a deer in their lives." There can be no doubt, that the mounds and remains of the Ohio and Mississippi valleys attest to the presence at one period of a numerous people, who must have depended in some degree on a rather extensive vegetable production. It is, however, singular with reference to this race, that there has never been found any trace of granaries, implements, or beasts of burden, or any other thing betokening a high or more than a rudimentary knowledge of the art.

These are conditions of existence in connection with the mound builders, and yet their era may have been so ancient, that time had obliterated all such remains while it left the mounds. I consider it remarkable in connection with this subject, that the bison (or buffalo) is found within a well defined area, nigh to the rivers where this ancient cultivation, as it may be supposed, had been practised. Gallatin is good authority for the relationship of this animal to the ox of the eastern hemisphere. What he affirms is curious, and deserves to be stated at length, as of some theoretical importance in considering the instincts of the species, and the antiquity of the American race. He says:—"The bisons are found in the Missouri plains, in flocks of several thousands. They generally migrate in winter to the country south of the Arkansas. * * Wherever a buffalo path is found in a mountainous or hilly country, *it is a sure guide* for the most practicable way of crossing the mountains."* He further says, and this is the important part—"The bison *is but a variety of the European ox;*" [what Dr. Gilpin would perhaps call the original type;"] "and the mixed breed will again propagate. As doubts have lately been raised upon that point, I must say that the mixed breed was quite common fifty years ago in some of the north western counties of Virginia; *and that the cows the issue of that mixture propagated like all others. No attempt* that I know of, *was ever made* by the inhabitants *to tame a buffalo of full growth.* But calves were occasionally caught by the dogs and brought alive into the settlements. A bull thus raised was for a number of years

* This is also known of the European ox in our own latitude.

owned in my immediate vicinity by a farmer living on the Monongahela, adjoining Mason and Dixon's Line. He was permitted to roam at large, and was no more dangerous to man than any bull of the common species. But to them he was formidable, and would not suffer any to approach within two or three miles of his own range. Most of the cows I knew were descended from him. For want of a fresh supply of the wild animal, they have now merged into the common kind. They were no favourites, as they yielded less milk. The superior size and strength of the buffalo, might have improved the breed of oxen for draught; but this was not attended to, horses being almost exclusively employed in that quarter for agricultural purposes." Mr. Gallatin draws no ethnological influence from these facts concerning the American bison. Messrs. Nott, Gliddon and Agassiz would probably deem them to be a distinct creation, as well as the red man. An argument of a contrary nature, may however be hazarded. The inference I would draw from the numerous herds, estimated at seven millions strong, that now run wild over the North American prairies, where they find climate and herbage suited to their fullest development, may just amount to nothing, but, it is neither impossible nor improbable. The wild bison, apparently untameable, may be the lineal descendant of the domestic cattle of the extremely ancient cultivators of the banks of the Ohio, the Missouri and the Mississippi—of the folded herds on which they depended for sustenance and labour. The barbaric irruptions which quenched this demi-civilization, may have been prompted by its bovine wealth; and may have destroyed and fed upon the captured herds. There would be nothing surprising in the indefinite multiplication of those which escaped and became wild, or in their intractable nature, worried and hunted as they have been for thousands of years. There was nothing in the condition or state of the Indian races before the advent of the Europeans, that could have prevented that multiplication. The hunter afoot, with spear, bow and arrows, may occasionally have surprised and killed a few of the herd, and some may now and then have been trapped; but they must have been too wary to have suffered any sensible diminution from the arts of savage circumvention, and rather despised them. On the contrary there is strong proof that from a central region and confined area they had increased both in numbers and geographical limits, north and south, east and west, up to the time of the European discovery. They then ranged the Missouri prairies from the fifty-fifth degree of latitude to the sources of the rivers that empty into the Gulf of Mexico, between the Mississippi and the Rio Norte. They had penetrated down the Rio Colorado, of California, as far south as the fortieth degree of latitude, and Lewis' River, a southern branch of the Columbia, as far west as the one hundred and fifteenth degree of longitude. Towards the east they had crossed the Mississippi, and before they were driven away by the American settlements, they had ascended the valley of the Ohio within 100 miles of Pittsburg, and that of the Tennessee to its sources.* It became a different affair, however, when the gun was placed in the Indian's hands, and he was mounted on horseback. From that time we may date the declension of the bisons; and it is no longer difficult to prophesy the period of their total extinction, which will probably be a century or two before the same fate befalls the red man himself. This is rather a digression, although I deem it an interesting one, and in some degree corroborative of facts which assist the conclusions to which these agricultural observations tend. The mounds and other remains attest a population that did not altogether depend upon animal food for their sustenance. Whatever were their means of support, or extent of civilization, they were destroyed by irruptions of barbarous tribes, who did not succeed them as permanent residents, and soon lost all recollection of the events by which the settled people were expelled or destroyed. The bisons, however, must have remained. In the long process of ages, the agriculture and civilization of Mexico, which probably resulted from the retreat southwards of the cultivators made an impression again upon these regions, and the present race of Indians acquired from them just so much knowledge as they now possess of the cultivation of the soil, which the men who considered the occupation beneath their dignity, committed to the women. The cultivation found in America at its modern discovery, whether recent or proceeding from that which was ancient, does not show either the origin or descent of the race who practised it; and only carries back their antiquity to a period when they had long inhabited the country, and when

* Gallatin.

the increase of population and the spontaneous fertility of the soil, and the newly found value of the maize as an article of food, had somewhat lessened the previous entire dependence upon the chase, and introduced and encouraged a nascent civilization. *

EVIDENCE DERIVED FROM ARCHITECTURAL REMAINS AND ETYMOLOGIES.

There is a wide field for speculation in view of the information communicated of late years, connected with the remains and ruins of an apparent civilization that once existed and was overthrown in the central parts, if not on some of the northern rivers of this continent. We have shown that the wildest conclusions have been hazarded, which follows from allowing the mind to wander from probabilities to a belief in the impracticable. The architectural and other remains of the Mexican and Peruvian nations, are deserving of attention as attesting to the originality of conception, the settled condition, and the progress in art and science which distinguished them. The massive construction, and the excellent workmanship of Egyptian and Indian architecture, are present; but the design, except as betokening a certain sameness of ideas in the human mind, which may be styled the instinct of art, is neither African, Asian, nor European. The form of the principal structures and mounds, the picture writings, which however are not hieroglyphics, the progress in astronomy, the worship of the sun and moon, have carried conviction to some minds that the ancient Egyptians or Assyrians were concerned in teaching the Americans what they knew of art, science and religion. If I could bring myself to suppose that these were of foreign instigation, I might be led to believe that they had some

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* "The country over which an imperfect aboriginal cultivation extended, is said to be that which is bounded on the east by the Atlantic; on the south by the Gulf of Mexico; on the west generally by the Mississippi, or perhaps more properly by the prairies; on the north the boundary of cultivation was near the Atlantic, and included the Kennebec River and probably the Penobscot. [There is no evidence that it extended to Nova Scotia, although maize in some seasons produces largely, and is every year an average crop.] With the exception of the Hurons and other kindred tribes on the northern shores of Lake Erie, there was no cultivation north of the great lakes, nor does there appear to have been any among the Chippewas, who occupied the country along the northern border of Lake Superior. They and the Menomonies depended for vegetable food principally, if not altogether on the wild rice, or wild oats as the plant is called. The few tribes west of the Mississippi, which attend at all to agriculture, as well as those which extend thence to the Pacific, derive their principal means of subsistence, either from the buffalo, or from roots and fish."—*Gallatin.*

connection with an ancient Egyptian or Asian advent to this particular portion of the continent. There are certainly some coincidences which must appear remarkable. They are limited to the central portions of America, and to Peru. The observations of Humboldt previously quoted, with reference to the names of *Chimborazo* and other mountains of Peru, that they had no significance in the language of the Incas, have some importance when it is known that there was a city of *Chemmis* in Egypt *—which may mean, the city of Ham; that the original name of the Egyptian nation was *Cham* or *Chimmi* (progeny of Ham); that one of the mountains of Central Asia, where the ark is said to have rested, adjacent to a territory claimed by philosophers as the true centre from which the human race spread after the Flood; and which may have been named, as Egypt was, after Ham, is *Chimalari*. Can all this be accidental? Does it point to an arrival on the shores of Mexico or Peru, of strangers from Asia and Africa, who gave a name to *Chimborazo*, which has survived all remembrance of themselves, and is the only memorial of their existence; and might not such strangers have brought with them a knowledge of some of the arts of civilized life? Further than this, we have in the names of some of the Mexican tribes what may be a similar derivation. The *Chichimecas* preceded the Aztecs in Mexico. Do some of the oldest Indian families or tribes of the continent derive their names from the same source? The affix *tl* in many words of the vocabularies of the *Chinooks* of the Columbia and other tribes of Nootka Sound, has been quoted as proof of their relationship to the Mexican or Aztec family. What then shall we say of their prefix, or the prefixes and affixes of some of the oldest tribes—of the analogy of the consonants *Ch*, and the syllables *Che* and *Chi*, viz., the *Choctaws*, the *Cherokees*, the *Chickasaws*, as well as the *Natches*, the *Muskogees*—and further north the *Chippeywans* and the *Chippewas*, and many other tribes, as distinguished from such names as the Mandans, the Minetares, the Sioux, and other mellifluous tribal designations. The Egyptians were early acquainted with navigation, and it is supposed explored the eastern coast of Africa at a very early period, as afterwards most probably did the Tyrians in partnership with the Jews; also the Carthaginians; and all or either may

* Herodotus.—Euterpe, 91.

by bare possibility have influenced the civilization and the superstitions that once prevailed upon this continent, and which antiquarians are so anxious to ascribe to them. It is almost certain too, that if they reached the shores of America, they would not be able to find their way back, and must have been content to make the best of the situation, and that the discovery could therefore have availed nothing so far as the eastern hemisphere was concerned. The Mexican legend of a great benefactor, Quetzelcoatl, whom they deemed a god, who came amongst them, gave them laws, taught them agriculture and caused them to live a settled life, is strong evidence of such an arrival. The departure from them of this personage, after prophesying that strangers would one day arrive from the east to impart further knowledge, was perhaps an attempt to return by the way he came, which was never destined to be realized.

These are probabilities and not impossibilities, and are therefore at variance with the many impracticable theories started by those who would assume for the human race on this continent a separate creation, or an indefinite duration. I cannot say that I agree with them, although pleading all the importance to which they may be justly entitled; they come in as a questionable addition to my theory, and if they do not militate against it, do not support it. I do not myself allow that the foreign derivation of either the arts or the civilization that prevailed in this continent, is proved by such evidence. That of names may be just as readily pleaded for a pre-Noachite descent, and a native or local origin. There were—there must have been other *Chams*, *Chims* and *Ches*, amongst the antediluvians, long ere the sons of Noah were born; and the tribes of America, and some of its mountains also, may have been called after them. With this idea the connection and analogy between an Egyptian and American civilization cease in my mind; and the pre-Noachite antiquity is sustained by the primeval structure of language, and the unique type which is characteristic of all the works of man, and of man himself upon this continent.

Nor do I believe that the American architecture is of very high antiquity. Comparing the ancient remains of Asia, Africa and Europe with those of America, it may be a fair way of dealing with them, to calculate their age by the effects which time has produced upon them. Those of Nineveh, Babylon, Egypt and

Jerusalem, with some striking exceptions, are buried at a considerable depth under ground, and the excavations to reach them are exceedingly troublesome. The traditions of antiquity and history had long been examined in vain for traces of some of the most remarkable of these ruins; and it is only in their recent exhumations in the East that mankind is beginning to read the history of the past. The relics of the ancient cities and temples of America *are upon the surface*, sometimes covered with trees and vegetation, but none are buried deeply under ground. That many of them are of great age, and their origin unknown, is unquestionable; but in these respects they do not differ from the very ancient remains of the eastern hemisphere. An inference, whether correct or not, that I would draw from this comparison is, that they are of a much more recent date,—that the era in which they were constructed is more recent,—and that probably two thousand years would cover the civilization which then and previously prevailed. I would take none of them to be as old as the relics of Nineveh, the Birs Nimroud, or the latest of the Egyptian pyramids,—that in fact, when the Spaniard arrived in Mexico, whether its civilization had or had not been affected by that of the eastern hemisphere, it was still the same as it had been, progressive perhaps, but perpetuating usages and customs, and producing the same architectural forms. With regard to the antiquities of the United States, Schoolcraft, than whom no one had more ample opportunities of judging, asserts, that "they are the antiquities of barbarism, and not of ancient civilization. Mere age they undoubtedly have; but when we look about our magnificent forests and valleys for ancient relics of the traces of the plough, the compass, the pen and the chisel, it must require a heated imagination to perceive much if anything at all beyond the hunter state of arts, as it existed at the respective eras of the Scandinavian and Columbian discoveries."

Living as we do in a country which at one time the "Souriquois"* or Micmac tribe of Indians possessed and roamed and hunted through its length and breadth, extending themselves to Cape Breton, P. E. Island, and the south-western coast of Newfoundland, it may not be out of place to advert shortly to what is known of their state when Acadia was first visited by

* The proper tribal name of the Nova Scotian aborigines.

Europeans. The country itself afforded no evidence whatever, of any prior occupation by a complete or demi-civilization; and appears to have been almost the last portion of the Continent inhabited by the American race; as it was also the last which the civilization of Europe deemed worthy of settlement. This is true, but a striking contrast to its present growing importance in natural resources, and as the great thoroughfare through which must pass at no distant day the commerce of Europe, Asia and America. The Micmac is an offshoot of the Algonkin family, and a true type of the North American race. The Algonkins are the most ancient, and are still the most numerous of the North American nations. This Lenape family, divided into numerous tribes, often warring against each other, extended from the source of the Missinippi River to Hudson's Bay, crossing which their boundary went westwardly through Labrador to the extreme boundary of the Labrador Esquimaux on the north shores of the Gulf of St. Lawrence; thence by the Atlantic Ocean and including Cape Breton and the S. W. coast of Newfoundland to Cape Hatteras; thence by a westerly line to the confluence of the Ohio and Mississippi; thence to the source of that river; thence the Red River of Lake Winnepeg down to that Lake; thence by a northerly line to the Missinippi. The Algonkin has always been a compound of the hunter and fisher, living near to the great lakes and rivers, or in countries bordering the Atlantic. The fashioning and construction of his canoe, which under his management is able to ride out a gale, but guided by an European would upset in a calm, is a most artistic piece of aboriginal naval architecture. There is no evidence whatever that he ever settled down to a civilized life. He may have come *after* and made war upon more southern tribes; and his ancestors may have been of those who helped to destroy the ancient settlements and demi-civilization of the Ohio and Mississippi valleys; but if so he profited little by the example at home, although he may have learnt some of their arts by the contact. Thus, in several of the Algonkin tribes maize was cultivated; copper

* Missinippi is an Algonkin word, signifying "the gathering of the whole *waters*." Mississippi is another Algonkin word signifying "the collection of *all the rivers*,"—a palpable distinction, but showing the wide extension of the family.

was known and used* in all the tribes; and all of them had the art of making a rude pottery, which they ornamented with small cubes of iron pyrites. They clothed themselves with skins of beavers, moose, &c., and made boxes, baskets and purses, which they ornamented with porcupine quills, and dyed of various colours. The cultivation of maize had not however extended to the Micmacs, although they knew the value of some indigenous roots, especially the sa-ga-ban, or Indian potatoe. Neither has there ever been found any burial mounds in this Province. They mourned their dead with loud lamentations, and buried them in graves dug in the earth. Their religious or rather superstitious observances, so far as known, coincided with those of all the other branches of the family, and generally with all the families of the North. Their language is an Algonkin dialect, which was very well understood by the Algonkins of Canada, and it would seem that the various tribes could converse with each other without difficulty. They were sometimes at war with their neighbours and scalped their enemies, of whom the Mohawks or Iroquois were the most dreaded. As the forests were plentifully inhabited by the moose, carriboo and bear, the wolf, (for there were wolves when the French made their settlement at Annapolis,) the lynx, the raccoon, the fox and the hare; and the inland waters by the beaver, the otter, and smaller animals; while the rivers and sea coast provided fowl and fish and mollusks, the Micmac must have been the best fed and clothed of any portion of the Indian race, and was fast increasing in numbers. But he affords no conclusive evidence of the antiquity of the American man. We find his bones, and his weapons buried with him, in Indian graves; and in the *Kjöckenmödding*, (adopting the name of the Danish antiquaries,) on the shores of some of the bays and harbours, are relics of pottery made of a coarse clay which had withstood the fire, stone axes, spear heads, and arrow heads, bone needles or piercers, mingled with shells of the quhog (*venus mercenaria*), clam (*mya arenaria*), all recent; and bones of the moose, bear, porcupine, beaver, &c., (all existing species), the large bones split for the sake of the marrow, and not yet fossilized,

* Membertou, Sagamore of the Souriquois, made a pretence of giving to De-Monts for the King of France, Henry IV. what he called his copper mine, supposed to be Cape D'Or.

all of which animals he hunted, ate, and appropriated their furs to make his own clothing; and at length traded them with Frenchmen who came from the great river of Canada, (the St. Lawrence,) with that object.* It is to be hoped, that when we have a Provincial Museum, a general collection of all such relics will be made and deposited therein, in order that the recollection of the stone age in Nova Scotia, distinct from the age of civilization, which last may date about 260 years back, shall not be forgotten or lost. Judging from the absence of all attempt at cultivation, for which in fact there was no necessity, and that the Micmac built no mounds, and had no pictorial writing, and that his remains as found are of comparatively recent date, I would not feel justified in fixing his occupation of Nova Scotia, at a much earlier period than five or six hundred years since. Yet when the French first came to the country, the Micmac had no knowledge and no tradition of the past history of his own family, although he used iron implements introduced from Canada, which country was a prior discovery. DeMonts and Poutrincourt, who arrived in New France, (Nova Scotia,) March 1604 † and coasting west at length came to Annapolis or Digby basin, which they named Port Royal, and sailing up the river formed a settlement, found them a simple minded, intelligent race, somewhat superstitious, good specimens physically of the human family, well made, tall and stout savages, with perhaps as little of vice in their composition as was ever inherited by humanity. For any change in their persons and character in these respects, they are indebted to their intercourse with the imported civilization of Europe. They have adopted but few of its improvements, and it has never sat well upon them, added to their comforts, or increased their prosperity. But whatever may be alleged against them, it is still evident that a sense of injustice and wrong prompted their enmities, and that they were ever "more sinned against than sinning." They may have numbered several thousands on the peninsula when the Frenchmen arrived; and if we count them now at seven or eight hundred souls, all told, it will show the rate of

* All these were found in exploring one of their refuse heaps at St. Margaret's Bay, by the Nova Scotian Institute of Natural Science (on one of their Field Days a few years since,) and recorded by the writer in the published "Transactions."

† LesCarbot who wrote a history of LaCadia or New France, arrived the succeeding year.

decrease, and give some idea of the influence upon them of the manners and customs of the eastern world.

SUMMARY OF THE ARGUMENTS, AND CONCLUSION.

A fair interpretation of the Book of Nature, as opened to us in the colour and language of the American race; the geological possibilities and probabilities that may have affected facilities of communication with the eastern hemisphere; the structure of language and affinities of dialects; the relics of human occupation as exhibited in the singular mounds and other evidences of a nascent civilization and settled communities in the north extending from the Mississippi to the Ohio;—the original designs of their architectural antiquities, and the progressive civilization of Mexico and Peru,—warrant the conclusion, that the American family of men is unique, descended from the same stock but distinct from all the races of the eastern hemisphere, and of pre-existent antiquity. Unless we choose to look for that antiquity in the vagaries of those who assume several centres of creation, we must try and find it in the Volume of inspiration,—and in the history, which very many believe to have been communicated by God himself to Moses; although there is no reason whatever why it may not have been handed down by tradition and picture writing, and hieroglyphs, through the succeeding generations from Adam to Moses. Unless, I say, we can find a coincidence between that Volume and the book of Nature alluded to, I fear that all attempts to trace the origin of man upon this continent, may be deemed hopeless. I believe this can be found. If the evidence laid before you, which is but a small portion of what could be produced, is sufficient to prove his antiquity, it remains to find a valid reason, supposing the Noachian deluge to have destroyed the human family in Asia, why the human family of America should have been preserved. Nothing short of this, I am persuaded, would satisfy any religious mind, firmly believing that the world, and all that was therein of animal life, was destroyed by a flood. It is to this important part of the subject that I shall shortly advert, stating the ground upon which I rest my argument, which assumes the unknown from the known, by induction carried back to the time of the first peopling of America, and resting for corroboration on the attributes of the justice and mercy of the Almighty.

The great difficulty with philosophers in fixing the time of man's first appearance in America, is the Noachian deluge. Either they have tried to account for his advent after that event, which does not afford a sufficient antiquity, or any reasonable proof; or going beyond it, have assumed for him a pre-Adamite age. Had they looked for that appearance to an intermediate time between the Creation and the Noachian deluge, they might have been able to account for it independent of that cataclysm. Gallatin, whom I have alluded to, who while obliged to claim for the race the *highest possible* antiquity, is fettered by the Noachian event, places the first arrivals "after the dispersion," the evidence being the unity of the structure of the language throughout the continent; and then enters upon a calculation based upon thirty periods of duplication of three couples, that probably admits of no allowance for depopulation by wars, pestilence and other contingencies, to show that America began to be inhabited only five or six hundred years later than the other hemisphere—this passage being so far obscure that it is difficult to tell whether he means after Adam or Noah. Schoolcraft also is evidently hampered by a similar difficulty, and gets over it very clumsily. He says "Considered in every point of view the Indian race appears to be of an old—a very old stock. Nothing that we have in the shape of books is ancient enough to recall the period of his origin but the sacred oracles." He considers that if we appeal to these, "a probable prototype may be recognized in that branch of the race which may be called Almogic, from Almodad the son of Joktan," of whom indeed I can find nothing recorded except that "Joktan begat Almodad and his eleven brothers, and that their dwelling was from Mesha as thou goest unto Sephar, a mount of the East." *

The Old Testament is a reliable book of history; and the only reasonable authority extant when we look back upon the origin of mankind, and their progress in knowledge, civilization and refinement. From that we learn that at his creation man was in intimate communion with his Maker. For some time after the Fall, and when he began to multiply, he knew God. In the days

* Genesis chap. v.

of Enos, we are told "then began men to call upon the Lord." The earth at that time was not corrupt and wicked, nor did it so become before the time of Enoch, who himself "walked with God." Suppose that a portion of the human family, after devious wanderings, had about that time reached this continent, they would have been of the pure Adamic stock; have brought with them the worship of the true God in its purest form; the original structure of language; and as much idea of the arts as then existed in the country from which they had come out: but they would not have been known to Noah or to the wicked race who were destroyed. Let us now turn to the American Indian as he first became known to Europeans, and we shall see that he fulfils the conditions of such a people.

The moral and religious character of the wild Indian of Northern America, as he appeared to the modern discoverers, with all the superstitions that thousands of years had grafted upon it, does not suffer by comparison with that of the races of the Eastern hemisphere. Except as regards the manifestation of the Son of God, his religion was probably as pure a theism as was that of the Jews. This then was his normal condition. We may not however deny that idolatrous practices were found in the central parts of America, for which it is not easy to account, except from the natural proneness of man, (as evinced also in the eastern hemisphere,) to embody his own conceptions of Omnipotence, and to worship God by bestowing divine honour upon the works of His hands; or that it was of foreign origin. The Mexicans, and further south the Peruvians, adored the sun and moon with some such mental reservation, and the former added to this iniquity the sacrifice of human beings. In like manner a few of the more north ern tribes partook of this idolatrous influence. None of them, however, lost the transcendant idea of a Supreme Being, to whom all others were subordinate. They believed in the immortality of the soul, in a good and evil principle, in a future reward for the virtuous and punishment for the wicked. The deep impression on their minds of these fundamental truths does not warrant us in believing that their idolatry had been of very long continuance, but the contrary. In the eastern continent the worship of strange gods may be said to have commenced with the immediate descendants of Noah, and may therefore have been *latent* in *his* family. It early acquired strength and overlaid a true conception of the Almighty, in Nineveh, Egypt, and Babylon; and had probably originated, culminated and been destroyed in the eastern world, before it began upon this continent. We may therefore certainly infer, that at the discovery of America, save the idolatry of Mexico and Peru, which so many believe to have been imported, the race upon this continent, like the Jews, did preserve the pure worship of God from the remote period of their immigration before it had been corrupted in the old world, long subsequent to the date assigned for the Noachian deluge, and probably to within the Christian era.

Many authors who have written on the American aborigines, have alluded to their tradition of a deluge, from which few escaped, to prove thereby that they were descendants of Noah. This tradition as it is supposed to refer to the scriptural event, is not of much weight, and ought to be received with caution, in determining the antiquity of the race. Much of it may have originated in the teaching of Europeans, who brought with them the Mosaic account of the deluge, pointing to the proofs of convulsions on every hand as confirmative evidence. The aborigines themselves have little or no tradition which points to deluges occurring beyond their own confines: and the geological conformation of the country, the terraces on the rivers, and the visible volcanic and other natural disturbances, carry conviction of the fact that there must have been inundations and submergences of land on this continent at periods within the human chronology. Nor is the tradition so universal as is generally supposed, although it remains with some of the tribes whose ancestors may have been subject to such visitations.

Again, the idolatry of Mexico and Peru may be said to have acquired its greatest strength at or about the time of the European discovery of those countries. It was limited within well defined areas, and its influence had not yet spread to any wide extent beyond those common centres. It was an idolatry similar to that of ancient Assyria and Persia combined, which existed some thousand years previous. In Europe or Asia, at the time of the discovery of America, there was no such religious worship. It had nothing in common with the superstitions of the African tribes of men. But the fundamental belief, even some of the customs akin to those of the Jews, which may have been transmitted from Adam, were generally remarked, and remained to show that the fire worship, adoration of the sun and moon, and idol worship, had been engrafted on the true worship of God. This idolatry, it is just to infer, would have grown gradually from priestcraft, and an assumption of supernatural powers by a privileged class amongst an ignorant people, always ready to evolve the supernatural out of natural phenomena; and may therefore have been, as I believe it was, indigenous.

The idea that the American race were idolatrous from the beginning cannot be entertained for a moment. The superstitious observances which among the more northern families, clouded a true conception of the Deity, evidently were produced from their mode of life, and peculiar habits, long after they had multiplied in the land. If this be so then, we may not believe that they were corrupt at the time of Noah; or that it consisted with Divine justice and mercy that the people of this continent should have been destroyed in the overthrow of the ungodly.

Amongst the many hypotheses and theories which have been hazarded to account for the peopling of America, there is none in which the evidence, although circumstantial, is so safe, as that which points to the appearance of man upon this continent at a period intermediate between the assumed date of the Creation and that of the Noachian Deluge. That period will afford a sufficient time for all the various phenomena connected with the race, which I have previously described. If we grant that the continent may have been or was so peopled, all the various phenomena connected with the progress of the American race up to the period of the European discovery, follow in their natural order. The fact as I view it, neither conflicts with the condition and progress of mankind, as these are recorded before the Noachian flood, nor with the demand that Christianity makes upon the common salvation. It would be well, I think, if this belief were so firmly established as to be generally received, and so to supplant or supersede the various speculations that perplex men's minds, and lead astray from a true conception of the wise and beneficent designs of the Creator of mankind. Should this paper lead to further enquiry which may contribute to such an end, I shall be amply rewarded.

ART. V. NOVA SCOTIAN LEPIDOPTERA. BY THE REV. CHAS. J. S. BETHUNE, M. A., *Secretary to the Entomological Society of Canada*, WITH ADDITIONAL NOTES BY J. MATTHEW JONES, F. L. S.

[*Read February* 8, 1869.]

IT is always a pleasure to a naturalist to examine a collection of specimens from a distant part of his own country, particularly if they belong to his own special department of study. This pleasure was kindly afforded me last year by the President of the Institute, J. Matthew Jones, Esq., who sent me for examination and identification a box of Lepidoptera collected in Nova Scotia. The specimens were chiefly *Heterocera*, though a few interesting little butterflies were also included amongst them. So little has been published (as far as I am aware) respecting the Insect Fauna of Nova Scotia, that I have been led to prepare the following list of the species sent me, in the hope that it may prove a small contribution towards a complete and systematic history of the order to which they belong.

Regarded as a whole the species corresponded to a remarkable extent to those taken in the neighbourhood of Toronto, and other parts of the Province of Ontario; so much so that one would hardly have imagined that they came from so far distant, and in many respects, so different a locality as the Maritime Province of Nova Scotia. It is interesting to find—if one may judge from so limited a collection—that the insects of the whole Dominion present so much similarity in their specific forms.

The following is a list of the species that I was able to determine, with the special Nova Scotian localities appended by Mr. Jones:—

RHOPALOCERA.

Fam. LYCÆNIDÆ.

Thecla ——?—This specimen corresponds very nearly to the description in Morris' synopsis of Lepidoptera of *T. iris*, Godt,—an insect taken in the State of Georgia; but the account is too brief to enable me to identify the species with certainty.

Polyommatus porsenna, Scudder.—A rare butterfly in Canada;

I have taken it occasionally in June on the Humber and Credit Plains near Toronto.

[This butterfly, which is the only one of the species I have seen during a residence of nine years in Nova Scotia, was captured by my friend, the late Rev. J. B. Freer, in September, 1863, on an open sunny spot near the house at Ashbourne.—J. M. J.]

Fam. HESPERIDÆ.

Nisoniades brizo, Boisd. and Lec.—Not uncommon in Canada and the United States.

[This specimen is very abundant about the end of June in open spots in the forest to the westward of Halifax, regaling itself upon the blossoms of the blueberry (*Vaccinnium Canadense.*)—J. M. J.]

Hesperia hobomok, Harris.—Our commonest skipper.

[The same in Nova Scotia.—J. M. J.]

Hesperia Peckii, Kirby.—This species I have found common about white clover blossoms on the sparsely wooded plains of the Credit, as well as in other parts of Canada.

[Frequents old log roads, and other open sunny spots in the forest near Halifax.—J. M. J.]

Hesperia mystic, Edwards.—Rare; taken in Connecticut, Michigan, Ontario. (Pro. Ent. Soc. Phil. ii. 15, plate 1.)

[Not uncommon about Halifax.—J. M. J.]

Hesperia nemoris, Edwards.—Only recorded as having been taken at Portsmouth, Ohio. (Pro. E. S. Phil. ii. 507, & vol. iv. plate 1.)

HETEROCERA.

Fam. SPHINGIDÆ.

Sesia diffinis, Boisd.—Common throughout Ontario, about flowers in the heat of the day.

[Common about Halifax. Frequents the flowers of the lilac at mid-day. —J. M. J.]

Hæmorrhagia thysbe, Fabr (*Sesia pelasgus*, Crane.)—Not uncommon with the preceding.

[Taken with S. diffinis, but not so common about Halifax.—J. M. J.]

Darapsa choerilus, Cram.—Common in Ontario.

Deilephila Chamáenerii, Harris.—Some years I have taken numbers of this species hovering at twilight about the flowers of the lilac, but it is generally rare in Canada; *D. lineata*, Fab.—is a much more common species with us.

Smerinthus geminatus, Say.—Common in Ontario.

Smerinthus excáecatus, Smith.—Not so common with us, occasionally attracted by light into houses, like many other Sphinges and Bombyces.

Sphinx kalmiáe, Smith.—Common in Ontario.

[Very common on the flowers of the honeysuckle at night in July about Halifax.—J. M. J.]

Sphinx gordius, Cramer.—Rare in Ontario.

[Not so common as the preceding species about Halifax.—J. M. J.]

Fam. ZYGAENIDÆ.

Ctenucha virginica, Charp. (*latreillaria*, Kirby)—Common in Canada; larva feed on the white poplar.

Lycomorpha (*Glaucopis*) *pholus*, Drury.—Quite common in Canada. The specimen sent me was an excessively tiny one, not more than half the usual size.

[Rare about Halifax.—J. M. J.]

Fam. BOMBYCIDÆ.

Crocota rubicundaria, Hübn.—A common species in neglected fields on the borders of woods; taken in the day time.

[Rare about Halifax.—J. M. J.]

Platarctia (*Arctia*) *parthenos*, Harris.—This very beautiful species is excessively rare in Ontario; though on our Society's list I had never seen a specimen of it before receiving the one sent for inspection by Mr. Jones. I should be very thankful for specimens of it both for myself and my correspondents; other species would willingly be given in exchange for it.

[It is by no means common about Halifax, but a few specimens may be obtained during the summer at lamp-light.—J. M. J.]

Pyrrharctia (*Spilosoma*) *Isabella*, Smith.—Very common in Ontario; the image of the familiar red and black "woolly bear" caterpillar.

[Common about Halifax.—J. M. J.]

Orgyia leucostigma, Smith.—Common in Ontario.

[Not common about Halifax.—J. M. J.]

Ichthyura (*Clostera*) *albosigma*, Fitch.—Rare in Ontario.

[Rare about Halifax.—J. M. J.]

Ichthyura (*Clostera*) *inversa*, Pack.—I have taken a specimen of this rare moth in the neighbourhood of Toronto, and Mr. E. B. Reed, at London, Ontario. Dr. Packard (Pro. Ent. Soc. Phil iii. 352), only mentions Maryland as its habitat.

[One specimen taken at lamp-light in room, at Ashbourne, near Halifax July 4, 1863.—J. M. J.]

Datana ministra, Drury.—The larvæ of this moth are frequently very destructive to the foliage of apple-trees towards the close of summer, in many parts of Ontario, New York, etc.

[Common about Halifax.—J. M. J.]

Nadata gibbosa, Smith.—A very rare insect in Canada; it is recorded to have been taken in Maine, Mass., and New York; the larva is said to feed on oak-leaves.

[Common.—Taken at lamp-light in room, in July.—J. M. J.]

Lophodonta ferruginea, Pack. ?—I am not quite sure as to the identity of this specimen, but I think it is correctly determined; it was quite new to me. Dr. Packard gives Massachusetts as its habitat.

[Rare about Halifax.—J. M. J.]

Edema albifrons.—Not uncommon throughout Canada.

[Rare about Halifax.—J. M. J.]

Dryopteris rosea, Walk. (var. *marginata*, Walk.)—This and the following species, both new to me, have not been taken in Ontario, so far as I am aware.

[Common about Halifax, coming to lamp-light in room.—J. M. J.]

Dryopteris irrorata, Pack.—"Brunswick, Maine, taken at light in August," (Packard, Pro. E. S. Phil. iii. 377).

[Halifax, not so common as the former.—J. M. J.]

Anisota (*Dryocampa*) *stigma*, Hübn.—Rather rare in Ontario.

[Also rare at Halifax.—J. M. J.]

Anisota (*Dryocampa*), *rubicunda*, Fabr. — Also rare in Ontario; *A. senatoria* is our commonest species.

[Halifax rare.—J. M. J.]

NOCTUINA.

TRIFIDÆ. BOMBYCIFORMES.

Fam. CYMATOPHORIDÆ.

Pseudo-thyatira cymatophoroides, Guèn.—A rare insect in Canada.

[Halifax; rare.—J. M. J.]

Fam. BRYOPHILIDÆ.

Grammophora trisignata, Walk.—Also rare; another specimen of this genus was sent me, whose species I have not yet determined.

[Halifax; very rare.—J. M. J.]

Fam. BOMBYCOIDÆ.

Diphthera fallax, H. Sch.—This beautiful black and green moth is quite rare with us. *D. Graefii*, Grote, being much more common.

Acronycta oblinita, Smith.—Taken in various parts of Canada but not so common as several other species of the genus.

[Halifax; common.—J. M. J.]

Acronycta ——— ?—This and two other species of the genus which I was unable to determine with certainty.

TRIFIDÆ. GENUINÆ.

Fam. LEUCANIDÆ.

Leucania pallens, Linn.—A common species of this destructive genus.

[Halifax; far too common.—J. M. J.]

Fam. APAMIDÆ.

Hydrœcia lorea, Guén.—This and the following species are quite common in Canada.

[Halifax; common.—J. M. J.]

Hydrœcia nictitans, Walk.—Common in Ontario.
[Halifax; common.—J. M. J.]

Nephelodes minians, Guén.—Not common; I have taken it at Cobourg, Ontario.
[Halifax; not uncommon.—J. M. J.]

Nephelodes, rubeolans, Guén.—Very rare in Canada.
[Halifax; not uncommon.—J. M. J.]

Xylophasia lignicolora, Guén.—Quite common in Ontario.
[Halifax; not common.—J. M. J.]

Xylophasia lateritia, Esp.—Taken by me at sugar in June, at Cobourg, Ontario; not common.
[Halifax; common.—J. M. J.]

Mamestra arctica, Encyc.—Only too common. It is a nuisance to collectors who try 'sugaring,' and its larvæ, well known as 'cutworms,' are a plague to gardeners.
[Halifax; common.—J. M. J.]

Mamestra adjuncta, Guén—Rather an uncommon moth with us.
[Halifax; not common.—J. M. J.]

Celœna herbimacula, Guén.—Very common.

Fam. Noctuidæ.

Agrotis jaculifera, Guén.—Excessively common; larvæ very destructive.
[Halifax; not very common.—J. M. J.]

Agrotis devastator, Harris.—As common and noxious as the preceding.
[Halifax; common.—J. M. J.]

Graphiphora bicarnea, Guèn.—Rather rare in Ontario.
[Halifax; common.—J. M. J.]

Graphiphora lubricans, Guèn.—Excessively common.
[Halifax; very common.—J. M. J.]

Fam. Orthosidæ.

Ceramica exusta, Guèn.—Not uncommon; larvæ injurious to turnip crops.
[Halifax; common.—J. M. J.]

Fam. HADENIDÆ.

Phlogophora iris, Guén.—Not at all common in Ontario.

[Halifax ; common.—J. M. J.]

Philogophora anodonta, Guén. ?—Quite new to me ; not having Guénee's works at hand I do not like to assert positively that this is a correct determination.

[Halifax ; not common.—J. M. J.]

Eurois herbida, Den.—Not common,

[Halifax ; uncommon.—J. M. J.]

Hadena xylinoides, Guén.—Excessively common.

[Halifax ; not very common.—J. M. J.]

Fam. XYLINIDÆ.

Cucullia asteroides, Guén.—Rare ; it has been taken at Toronto.

[Halifax ; not uncommon.—J. M. J.]

Cucullia———?—This species seems to agree with the descriptions of the European *C. verbasci*, Linn. I am unable to determine it with certainty at present.

Fam. HELIOTHIDÆ.

Heliothis exprimens, Walk.—Not uncommon in Canada and the United States.

[Halifax ; rare.—J. M. J.]

Anarta Acadiensis, new species.—The pretty little species of this genus are chiefly confined to mountainous and sub-arctic regions ; one, however, is taken all over England, and another *A. luteola*, Grote & Rob., has been found in the neighborhood of Quebec ; Dr. Packard (Pro. Boston Soc. Nat. Hist. Oct. 17, 1866), has described several species taken in Labrador. The following is a description of our species :—

Anterior wings dull brick-red, sparsely powdered with black scales. Basal line indistinct, doubled, slightly dentate, black ; transverse anterior line black, perpendicular to costa for nearly halt its length, then curved outwards forming an irregular arc to the inner margin. Median space darker, with a transverse central black shade; orbicular spot very conspicuous, creamy white, with a few scattered ferruginous scales in the middle, narrowed posteriorly and produced till it meets the edge of the reniform; this spot is of the normal shape, concolorous with the rest of the wing, conspicuously bordered with white, except inferiorly where it is open and encroached upon by the dark central shade. Transverse posterior line, black, fine, forming a very convex arc outside of the reniform spot. Subterminal and terminal spaces paler; subterminal line rather broad, distinct, black, arising from a triangular black spot on the costa, slightly wavy, parallel to the outer margin; terminal line deep black, very distinct; fringes concolorous with the wing.

Posterior wings shining, straw-yellow, with a broad well-defined black border, which is slightly excavated interiorly just before the anal angle; costa, base and inner margin broadly discolored with black scales; fringes golden yellow at apex, pale yellow inferiorly.

Under side of anterior wings shining, the costa narrowly, and the outer margin broadly, reddish-yellow, especially at the apex; inner margin rather broadly pale yellow; all the rest uniformly deep black. Posterior wings shining, pale yellow, with the costa and apex broadly irrorate with bright ferruginous scales, and a narrow ill defined submarginal band; fringes pale yellow.

Antennæ pale ferruginous, with a slight pubescence. Head and thorax ferruginous. Abdomen cinereous above, darker from numerous black scales below; anal tuft ferruginous. Tarsi annulated.

Alar expansion 1.15 inch. Length of body 0.50 inch.

Habitat, Nova Scotia. (No. 281, J. M. Jones). This very pretty little moth may be readily distinguished by its color and the conspicuous peculiarly shaped orbicular spot.

[Halifax; rare, taken in July at Ashbourne.—J. M. J.]

QUADRIFIDÆ—VARIEGATÆ.

Fam. Plusidæ.

Plusia æreoides, Grote.—Not uncommon in Canada.

[Halifax; not uncommon.—J. M. J.]

Plusia ampla, Walk.—Rather rare.

[Halifax; not uncommon.—J. M. J.]

Plusia simplex, Guén.—Very common, often found flying in the daytime, and frequently attracted by light at night.

[Halifax ; common.—J. M. J.]

Plusia festucæ, Albin.—A rare and very handsome species; it is taken in Europe also.

[Halifax ; not uncommon.—J. M. J.]

Plusia thyatyroides, Guén.—A very pretty insect, rarely taken in Canada; I had never seen a specimen of it before.

[Halifax ; rare.—J. M. J.]

Plusia ———?—This and another species that I am unable as yet to determine satisfactorily.

Fam. GONOPTERIDÆ.

Scoliopteryx libatrix, Linn.—Very common both in Europe and America; I have taken scores of specimens at sugar. Its larva feeds upon willow.

[Halifax ; excessively common.—J. M. J.]

QUADRIFIDÆ—LIMBATÆ.

Fam. CATOCALIDÆ.

Catocala relicta, Walk.—An exceedingly beautiful and rare insect; its colours, black and white, render it easily recognisable. I have taken it occasionably at Toronto and Cobourg, Ont., and Mr. Pettit has obtained it at Grimsby, Ont.

[Halifax ; very rare. The only specimen I have ever seen.—J. M. J.]

Catocala concumbens, Walk.—A handsome crimson under wing; rather common in Canada.

[Halifax ; very rare. This is the only specimen I have taken, I obtained it in the day time on the trunk of a tree at St. Margaret's Bay.—J. M. J.]

QUADIFIDÆ—SERPENTINÆ.

Fam. OPHIUSIDÆ.

Ophiusa bistriaris, Hübn.—Not uncommon in Ont.

[Halifax ; very common.—J. M. J.]

Fam. EUCLIDIDÆ.

Drasteria erechthea, Guén.—Our most common moth; any number may be taken in meadows in summer. Its larva has been recently described by my friend Mr. W. Saunders in the *Canadian Entomologist*, vol. i., p 4.

[Halifax; very common.—J. M. J.]

Fam. BOTYDÆ.

Pionea eunusalis, Walk.—Quite common in Canada.

[Halifax; common.—J. M. J.]

Fam. ENNOMIDÆ.

Angerona crocaotaria, Guén.—An exceedingly small specimen of this variable species; it is not uncommon in Canada.

Tetracis crocallata, Guén.—Common.

Tetracis aspilatata, Guén.—Not uncommon.

Fam. AMPHIDASYDÆ.

Amphidasys cognataria, Guèn?

[Halifax; very rare.—J. M. J.]

Fam. GEOMETRIDÆ.

Zerene catenaria, Harris.—Common at Toronto.

[Halifax; common.—J. M. J.]

Fam. FIDONIDÆ.

Lozogramma difluaria, Walk.—Rare.

[Halifax; rare.—J. M. J.]

Fam. LARENTIADÆ.

Scotosia undulata, Linn.—Not very common. I once took a live specimen of this insect in a farm-house north of Milbrook, Ont., where it was flying about in a warm room, on the 27th of February.

[Halifax; rare.—J. M. J.]

Cidaria diversilineata, Hübn.—Rather common.

[Halifax; not common.—J. M. J.]

A considerable number of the smaller Lepidoptera were also forwarded with the above collection, but several of them being quite new to me, their determination is deferred.

ART. VI. NATURAL HISTORY, AND ITS PLACE IN THE SCIENCES. BY T. F. KNIGHT.

[*Read March* 8, 1869.]

IT is somewhat surprising that with the desire for knowledge and the faculty of inquiry inherent in man, the ancients, while they apprehended the philosophy of nomenclature * and the true principles of classification, † penetrated so little into the domain of nature, which to them was in reality a *terra incognita*. The reason of this is summarily accounted for by the disciples of the inductive philosophy, from the doctrine that the process of induction or experiment was unknown to the ancient philosophers. It ought rather to be affirmed that it was known only in theory, and was never applied to the purposes of investigation and discovery.

The primitive names which were given to natural objects by the ancient civilized nations, were founded on the most marvellous fancies. The Greeks believed that "the narcissus which bends its head over the stream, was originally a youth who in such an attitude became enamoured of his own beauty; the hyacinth on whose petals the notes of grief were traced recalled the sorrow of Apollo for the death of his favourite Hyacinthus: the beautiful lotus of India which floats with its splendid flower on the surface of the water, was the chosen seat of the goddess Lackshmi, the daughter of Ocean. In Egypt too, Osiris swam on a lotus-leaf, and Harpocrates was cradled in one." Although the powers of observation were employed in the earliest times to detect the external differences of objects, no step was made towards scientific arrangement.

Among the less fanciful Hebrews, we find from their earliest records that natural objects both organic and inorganic bore permanent and infallible distinctions that correspond to the conventional names now in use; ‡ and, after they were stripped of their poetic embellishment, we find the terms used in the language of common life, by all nations, retaining their place for ages.

Some steps were however made in the inviting path of Natural History ere the classic period shed its resplendent light upon the

* Cratylus of Plato.
† Topics of Aristotle.
‡ The oak, cedar, bramble, rose: brass, iron: precious stones in high priest's breastplate.

slowly advancing world. Egypt had long had her fish-ponds, and was practised in the art of pisciculture. Solomon among the other evidences of his being wiser than all men, "spake of trees" says the sacred record, "from the cedar tree that is in Lebanon, even unto the hyssop that springeth out of the wall?" Herodotus too, shows us that a taste for natural history had, in his time found a place in the minds of the Greeks. * But more certain, and abundant knowledge was at a later period transmitted to the west from the Macedonian colonies, respecting those products of nature and art which had hitherto been only imperfectly known from commercial intercourse, or from the narratives of travellers to distant countries. Humboldt remarks that "the knowledge of a greater portion of the earth may now be said to have been opened for the first time." "The objective world" he adds, "began to assume a preponderating force over that of mere subjective creation, and while the fruitful seeds yielded by the language and literature of the Greeks were scattered abroad by the conquests of Alexander, scientific observation and the systematic arrangement of the knowledge already acquired, were elucidated by the doctrines and expositions of Aristotle." How just an eulogy of this great mind, who in almost every department, may be looked upon as the representative of the highest stage of knowledge and system attained by the Greeks; and, in his peculiar sphere unapproached by the loftiest intellect of any age! His works on Natural History which have been rescued from the spoils of time, are a valuable monument of the state of such knowledge in his generation. His treatise on plants has never been recovered.

A great accession was made to the knowledge of Natural History under the Egyptian Ptolemies, during which dynasty a museum of Natural History was founded and endowed at Alexandria. The Romans in this as in other subjects were practical, not speculative. Amongst the celebrated names which Rome has added to the world's *literati*, the name of Pliny is held in veneration as an industrious compiler of the knowledge of Natural History current in his day. Pliny's voluminous compilation acquired an almost unlimited authority, as one of the standards of botanical knowledge down to the Middle Ages.

* I. 193.

We now reach a period of darkness and mental lethargy, when commentators and mystics succeed the naturalists of better times. The only important service rendered to human knowledge during this period was the preservation and transmission to more enlightened times of the intellectual treasures of antiquity. Pliny and Aristotle now assumed an Arabic dress, and were the foundation of instruction in all the Arabian academies, from Bokhara in the east to Cordova in the west. The flourishing commerce of the Arabians made them practically acquainted with the products of lands unknown to the Greeks and Romans; but they never learned the art of converting their practical into speculative knowledge. They treated of plants only in so far as their use in medicine was concerned, and indulged the most superstitious notions respecting their healing properties.

The revival of Learning gradually dissipated the mist of superstitious erudition which characterised the Middle Ages. Ingenious and vigorous writers exposed the errors of the Arabians and even of Pliny; and the powers of observation were called into active exercise. Aristotle had divided animals into Quadrupeds, Birds, Fishes, Cetaceous, Testaceous, Crustaceous, Mollusks and Insects; and established the distinction in some of these classes of viviparous, oviparous, vermiparous, and had marked the differences in the teeth of animals. He had also a clear perception of the distinction between genera and species. He thus seems to have indicated in Zoology the founding of a system of nature. The division of vegetables into trees, shrubs and herbs, and their properties into aromatic, alimentary, medicinal, and vinous, now gave place to a more scientific classification founded on their structure. Hence, plants having a tubular flower, of which the mouth is divided into lips, are for the first time termed *Labiatæ*; others whose blossoms contained four petals arranged crosswise were called *Cruciferæ*; others, whose flowers were more complex were called *Compositæ*. Thus far we arrive at *species* included in *genera*, and genera grouped into *families* or *orders*.

We have come now to the latter part of the sixteenth century. We see the dawning of systematization based on observation of the physiological characters of organic nature. The recently discovered continent excited the curiosity of the observers of nature. Industrious explorers both Dutch and English had traversed the East Indies; Hans Sloane (whose Museum in London is an object of interest to botanists to this day,) collected the plants of Jamaica; and other collectors both in the West Indies and the American continent found objects new and interesting. About this time public botanical gardens were established all over Europe. The wars and troubles which prevailed over Europe during the greater part of the seventeenth century greatly checked the progress of science. At length, when a period of tranquillity succeeded, science shone forth with a new lustre. Contemporary with Newton flourished the celebrated English naturalist John Ray, who was the model of the systematics long after his death in 1705. Ray added many natural families to the science of Botany. He constructed his system partly on the fruit and partly on the flower. Tournefort, a French naturalist, who published his method in 1700, succeeded in giving to the characters of genera a degree of exactness never before attained; and inserted in his work a figure of the flower and fruit belonging to each genus. In Zoology, important strides were made in the seventeenth century from the causes already adverted to, especially in Ichthyology. On this sub-science Ray and Willoughby in England and Artedi in Sweden, poured the light of their genius.*

We now come to the period when flourished the greatest naturalist of that or of any age—*Linnæus*. As his life and labors can become familiar to any lover of books, I will defer a notice of his contributions to the cause of science to the second section of my paper; and that must be brief. The permanency of Linnæus' influence, even on the minds of this generation brings us almost down to the present hour, and exalts him to contemporary fame.

Before discussing the subject of classification, in which I purpose to treat of the antagonism which is maintained between the Artificial and the Natural method, it is incumbent upon me to refer to Cuvier the great expounder of the latter system, as Linnæus is recognized as the inventor of the Artificial system. The Artificial method is allowed to be Natural as to the narrowest members of the system, viz.—species and genera; but is called artificial as respects the wider groups. Hence Linnæus' method is pronounced to be artificial

* Whewell—Hist. Induc. Sciences.

as respects his classes and orders, founded upon the number of the stamina and pistils, which in many instances is maintained to the injury of natural alliances; and which Linnæus himself was compelled, in not a few instances to depart from, so as to preserve the obvious association of certain genera. Linnæus was eminently successful in detecting good characters for an artificial system whose principal use is the ready identification of allied genera. It was he who introduced into the characteristics of classification the number of rays of the fins in fishes. A Natural method is an attempt to provide positive and distinct characters for the *wider* as well for the natural groups. This principle which was but dimly seen in the study of vegetables, was more readily perceived in the study of animals, in which physiological relations of the parts are so manifest that they cannot be overlooked. Hence the superiority of natural systems in Zoology may be more generally allowed than in Botany; and no arrangement of animals which, in a large number of instances, violated strong and clear natural affinities, could be tolerated because it answered the purpose of enabling us easily to find the name and place of the animal in the Artificial system.* This incongruity was apparent to the inquiring mind of Cuvier; and in his *Regne Animal* first published in 1817, he introduced a new arrangement in the orders of *fishes* on the principle founded, not on their external parts but on their internal structure. But we witness the most attractive of his achievements in the recognition of the four great natural divisions of the animal Kingdom—the *vertebrata*, the *mollusca*, the *articulata*, and the *radiata*. This arrangement has maintained its ground, amidst all the varieties of minor classification; and it is not likely to be disturbed by any new discovery. This is a signal proof of the excellence of natural arrangement that being founded on internal structure it must be permanent.

I have thus far traced Natural History to its culminating period; I have now to deal with it as a science, to explain its laws and to define its boundaries. The only successful manner of showing the *rationale* of classification, is from a thoroughly philosophical standpoint. The objects which meet the senses, in the study of Nature are form and place, and the constitution and properties of

* Whewell.

bodies, *e. g.*, in the study of chemistry the objects of observation and investigation are the elements and constitution of bodies; of mechanics the powers of bodies; of organic nature the form, situation, structure, and functions.

There have appeared to me, the more that I have sought to penetrate the domain of knowledge, as well as to study the operations of the human mind in its pursuit of truth, that there are three grand instruments—*organa*—which every enquirer employs in the investigation of the moral and physical world around him. These are Language, Mathematics, and Experiment—language for the acquisition and communication of ideas, mathematics for the determination of number and quantity, and experiment as composed of the dual operations of analysis and synthesis. To accomplish analysis we observe, compare, and separate; to accomplish synthesis, we combine and re-organize. As soon as the phenomena which observation has discovered are defined and comprehended by the process of induction, general laws are established and true classification begins. (Any classification based on accident, or external marks, or locality as *Scomber* is no true classification.)

In observing any natural object we first discern a likeness to some object previously seen, and we at once pronounce it to be of a certain kind. (Aristot. genus). Next we examine more closely, and discover that it is capable of being narrowed into a more exact description and definition. Hence proceed the ideas in Natural History of *genera* and *species*; and these distinctions correspond with the best canons of the ancient philosophy. (In Aristotle difference is added to the genera and determines the species). To express this minute description, certain terms are used to define its features and properties, which are appropriate and intelligible, and this want creates a *terminology*. The terminology of the old naturalists was meagre and indefinite, and to Linnæus is due the formation of an exact and descriptive language for botany which has shed clearness and precision over all parts of the science. Zoology, geology, and mineralogy, have each their descriptive language, gradually improved and perfected through the labours of successive naturalists.

Next comes the distinguishing of similar objects; and this gives rise to what we call *nomenclature*. We probably gave the object at first sight the conventional name, which might be arbitrary and of accidental origin; if in the service of science we would give it a scientific name, corresponding to its external form or internal structure. This name will probably indicate the *genus*. We also find on a closer examination, that not only is there a likeness to the known objects which it resembles, but important differences; and this necessitates a new name to describe a narrower circle of objects having a *specific* difference. This we denominate *species*. The genus may be called the vestibule to scientific observation, and being determined by partial knowledge is not invariable. But in the species of organized bodies there is an invariability which nothing can change; and which is invaded only by death or extinction. By the same process of investigation a still narrower circle of *varieties* through accidental causes is discovered, and to this as to the other degrees of classification we apply the law of nomenclature.

Nomenclature is so far extended to genera, species, and varieties. It is now applied to a wider classification; and it is from this point that the antagonism of systems may be said to begin. For a readier identification of a great multitude of objects which have something in common, *genera* are grouped into *families*—*families* into *orders*—*orders* into *classes*—*classes* into *divisions*—and these into *kingdoms*—the widest generalization; but in the progress of scientific discovery, a closer examination of those forms of organic bodies which are near the boundary lines of the Animal and Vegetable kingdoms reveals that these artificial distinctions are often imperfect; and even the distinctions that unite the orders into classes, and the families into orders. I have described the characteristic features of the antagonistic systems—the artificial and the natural—in my remarks upon the two eminent naturalists Linnæus and Cuvier, and I need not repeat the description. It has been said of the natural system that it is based on types, not on definitions, and the main ground of objection to an artificial system is, that it is anti-progressive—that it stops at a given stage of progress, and dogmatically determines a fixed nomenclature. After all that has been urged by the respective adherents of the two systems, it must be admitted that every classification is to some extent artificial. Terminology is art.

Nomenclature is art. Linnæus himself fully comprehended the natural system as the goal of the explorer. Besides the recognition of the two primary divisions of the vegetable kingdom, he taught that the artificial classes are a substitute only for natural, until natural are detected. And the title of his great work "*Systema Naturæ*" indicates the inseparability of the two constituents in every system—*art* and *type*.

Any discussion of those respective methods would be imperfect without a reference to the Jussieus, father and son, who were the acknowledged inventors of the Natural System of Botany. This system in France and the United States has very generally displaced the Linnæan system; but it is not favourably entertained by German and English botanists. "The object of the Jussieus," remarks Dr. Whewell "was to obtain a system which should be governed by the natural affinities of the plants, while, at the same time, the characters by which the orders were ostensibly determined, should be as clear, simple, and precise, as those of the best artificial system." Linnæus' system, while it accepts the natural genera, does not seek natural families. The largest divisions, or classes, are arranged according to the number of the stamens, as *monandria*, *diandria*, *triandria*, &c., and the orders of each of these classes by the number of styles as *monogynia*, *digynia*, &c; but this system, though it regards natural characteristics, leaves certain natural affinities untouched. The Jussieus', on the contrary is founded on a larger number of natural affinities of organization and function. The fame of Linnæus, however, can never be obscured, as respects his exact terminology, the determination of genera, and the binary nomenclature—or the addition of the specific name instead of a descriptive phrase, to distinguish the species. And it is due to Linnæus to acknowledge that, in the last and highest division of the vegetable kingdom into Phenogamia and Cryptogamia, he indicated the natural method which was perfected by these two distinguished botanists.

In the Mineral Kingdom, although its division into classes and orders and even genera has been attempted, it is difficult to conceive how any system of natural classification can be introduced. Because there is no perpetuation by propagation, species is excluded; but affinities might become a basis of classification if the laws of combination of their elements could be accurately discovered. The knowledge which we principally seek concerning minerals is their chemical composition; but we must classify by other than chemical characters, if we would establish for minerals a natural system. Dr. Whewell has pertinently remarked, "If chemistry be called upon to supply the definitions as well as the doctrines of mineralogy, the science can only consist of identical propositions." As a guide to the recognition of mineral substances, their external characters were first compared, then chemistry was applied to analyze their properties, and thus a mixed system of classification was early in vogue. And indeed, this is the method, which in its general principle has been continued to our own time. (First were *earths*, *stones*, *metals*; then earths into *calcareous*, *siliceous*, *argillaceous* and *tke like;* and stones and metals into their several component characters.) To relate the attempts and failures at systematic reforms in the science of mineralogy would be tedious. Suffice it to say, that the elevation of this science to the beautiful generalizations which characterize zoology and botany, is a triumph reserved for future naturalists—if ever accomplished.

So much as to the *rationale* of Natural History—properly so called. I will now offer a few observations on its place in the sciences. There seems to be something indefinite in the term Natural History, even as comprehending the several sciences which are usually associated under this title. In the earlier ages, when the observation of the natural world was comprised within a few isolated facts—a mere record of the conventional name and locality of natural objects, as well as their use—the term would seem applicable, and would present an analogy to the term history as applied to the lives and actions of men. But inasmuch as in later times, the discovery of the principles which are deduced from human actions has given rise to another title distinct from the mere record of human deeds, viz: the philosophy of History—the great advance which Natural History (so called) has made in regard to classification and the discovery of general laws, the ancient title applicable to the meagre collocation or researches of early times is no longer appropriate. The observations of the ancients, as I have shown, had scarcely reached the incipient stage of classification, much less the more advanced stage of general laws; and with respect to the latter stage, it is admitted by the most enlightened writers on science of the present day, that no aggregation of phenomena is entitled to the appellation of a science until it has advanced beyond the stage of mere classification.

The definitions of Natural History are in most instances so vague and contradictory, that we look here in vain for any clear conception of the true boundaries of this interesting department of knowledge. Natural History has been defined as "that part of natural knowledge which teaches us to distinguish and describe the objects of nature—examine their appearance, structure, properties and uses—and to collect, preserve, and arrange them." This is the range of ideas generally associated with the study of Natural History. There *is* a more comprehensive definition than this—"that which considers under a single point of view, all natural bodies and the common result of all their actions in the great whole of nature. It determines the laws of the co-existence of their properties; it establishes the degrees of resemblance which exist between different bodies; and it classes them according to their degrees." This definition also admits of the distinctions of general and particular as to degree of minuteness in description. If we were to understand by the term Natural History, the history of nature, our sphere of investigation and discovery would be unbounded, but the technical meaning of the term confines it to a description of animals, plants, and minerals. The sphere of observation is thus partitioned into three great divisions—the Animal Kingdom—the Vegetable Kingdom—and the Mineral Kingdom. But it is evident, that as the several objects of investigation are better comprehended, and reach successively the stages of classification and science, a new and well defined name is attached to each sub-division. Thus we have under animals—Ethnology, Zoology, Comparative Anatomy; under plants—Botany and Vegetable Physiology; under minerals—Geology, Mineralogy, Comparative Geology, Crystallography and some other *ologies*.

But I want in my *ideal* to embrace the whole of visible nature; and thus I consider, Mr. President, that the title which you have given to the Society whom I have the honor to address to-night is the most appropriate that could have been conceived. It indicates the true scope of natural investigation. The lamented Humboldt was the first who employed such wonderful powers of generalization in comprehending the vastness and oneness of nature. He himself acknowledges in the second volume of the Kosmos that the elder Pliny is entitled to the merit of first embracing nature in this wide generalization. Quoting the ancient naturalist, he writes, "The path on which I am about to enter is untrodden; no one amongst my own countrymen, or amongst the Greeks, has as yet attempted to treat of the whole of nature under its character of universality. If my undertaking should not succeed, it is at any rate, both beautiful and noble to have made the attempt." He adds, "He (Pliny), in his Historia Naturalis, (composed in a true spirit of cosmical description) recognises the necessity of representing the forces and the glory of nature as a great and comprehensive whole." "A grand and single image floated before the mind of the intellectual author, but suffering his attention to be distracted by specialities, and wanting the living contemplation of nature, he was unable to hold fast this image." Not so the distinguished modern. He traversed every continent, and laid all lands under contribution to illustrate the laws which govern the harmonious and sublime phenomena of the visible creation.

In the brief survey of nature which I have attempted, I have not, it will be seen, by any means traversed the extent of this grand conception. There are many topics of interesting enquiry that I cannot touch. Of Geology and its cognate sciences I have said nothing, because it is so vast in itself that, the merest outline would exceed the limits of a single paper. And further, of Astronomy or Meteorology, incompetent as I should feel to undertake their exposition, I dare not if I could essay any description.

If I could so far overstep the bounds of modesty as to criticise the literature of science, I should be tempted to assail the existing inconsistency of trivial names applied to species, though sustained by the example of the renowned Linnæus. Although it is a dangerous experiment to alter unnecessarily the nomenclature of science, the natural system of nomenclature it is to be hoped will be generally applied to the narrowest distinctions of natural objects. It is no guide to the novitiate in scientific research to be supplied with signs that have their origin in accident only; but on the contrary, a nomenclature founded on some dominant type of organization or of function would be a ready guide to *every* explorer in the boundless field of nature. There are also contending theories that are of the profoundest interest from a psychological point of view, but they are for separate treatment, and will not I trust be excluded by the well defined title of the Society should any one attempt at any future time their discussion.

There are other topics obviously suggested to the mind in the study of natural science; but I have necessarily devoted so much space to the subjective, that the objective or natural science outside of itself, can have but a brief notice. Indeed, I can no more than indicate its scope.

1. It suggests to the human mind the idea of a great first cause or intelligent artificer of nature; and under this head might be discussed the doctrine of *final causes.*

2. Its study enlarges and strengthens the intellect; and is thus an important branch of education.

3. Its economic uses; and here a vast field opens to the view, and which would embrace almost every pursuit of art and industry amongst mankind.

I have not in this brief survey of natural science applied my enquiries to the discoveries and improvements of the present century. It was not essential to my purpose to do so, and so wide a field of research would have daunted the most confident, as well as the most acute of investigators. The great principles which lie at the basis of natural science had their solution at the close of the last, or at the beginning of the present century. Even Geology and Paleontology, the most recent of the natural sciences, had attained a solid foundation; when thus early the intimate connection that subsists between Zoology and the latter science was clearly demonstrated by the renowned Cuvier. Many and great conquests over ignorance and prejudice have however been made during this nineteenth century. By comparison of synonyms, and the agency of the press, and the industry of observers, countless interesting and instructive objects have enriched the public and private museums of all countries; and by the ever evolving power of induction, new laws have been promulgated, and have contributed to the perfection of these sciences. It is a pleasing reflection to the lover of nature, that while in the field of politics men are still engaged in intrigue, and in the theatre of war dynasties are still created or destroyed, the friends of natural science, each in his several sphere, are with loving hands assisting to erect an enduring temple that even Time cannot destroy. The objects that furnish material for thought may perish; but the immortal fruits are lasting as the mind itself.

If then, the observation and study of nature be so elevating, so profitable, and so enduring; and if we fully comprehend the sphere of natural science, we shall not restrict ourselves to contemplation only of the earth beneath our feet with its wealth of life and wonder and beauty; but we shall assert the dignity of our origin, and lift our gaze to the atmosphere that envelopes us, and even penetrate with the aid of its cunning implements the mysterious depths of the illimitable space. We shall not be content with pursuing our investigations only for the gratification which they afford; but we shall endeavor to discover new appliances for the promotion of industry, and wealth, and the happiness of the human race.

Art. VII. On the Meteorology of the Glace Bay Coal District. By Henry Poole.

[*Read April* 13, 1869.]

The accompanying register of the weather observed here in the year 1868, is in continuation of the Meteorological Register forwarded for the year 1867.

The mean barometrical readings for the two years vary very little: 29·8854 inches in 1868, against 29·8524 in 1867. The readings are corrected to the freezing point, and for an elevation of 60 ft. above the sea level, and also for the force of vapour. The force of vapour is an important element in the barometrical pressure, and during the year it gave a mean difference of 0.193 or nearly the fifth of an inch. The highest corrected reading was 30·611 on the 7th March. The lowest was 28·809 on the 6th February.

In February the greatest variations in pressure and temperature were observed. On the morning of the 5th the barometer stood at

30·371; during the following night the temperature fell to eight

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... mean, 2·206 m., and August the highest 12·61 m., the latter equal to 49.55 inches of mercury. June 5th was the dryest day when the relative humidity was only 20. On the 20th August

30·371 ; during the following night the temperature fell to

METEOROLOGICAL REGISTER, CALEDONIA MINE, LITTLE GLACE BAY, CAPE BRETON, 60FT. ABOVE SEA, LAT. 46°, 12 NORTH. LON. 59° 57′ WEST.

1868.	Barometer.				Thermometer.										Rain & Melted Snow.																							
	Mean corrected to 32°.	Correc. for Vapor & 60 ft. above Sea	Highest correctd.	Lowest correctd.	Mean.	Mean Night.	Mean Noon.	Coldest.	Hottest.	Relative Humidity.	Force of Vapour in Millimetres.	Degrees of Frost—32.	Nights of Frost.	Nights below zero	Days.	Rain in Inches.	Days.	Snow in Inches.	Wind total Revolutions.	Av. Miles p hour by Anemometer.	Extreme lbs. per square foot.	Greatest number Revolutions in 24 hours.	Least number Revolutions in 24 hours.	S. to W.	W. to N.	N to E.	E. to S.	Turned round with Sun.	Against Sun.	Fogs.	Hail.	Rimy frost.	Silver thaw.	North. Lights.	Halo Sun.	Halo Moon.	Light'g & Thund.	Rainbows.	Corona.
January	29.7086	29.675	30.493	28.914	15.65	10.3	21.0	— 3	40	79.8	2.364	671	31	4	10	4.665	9	10½	739445	19.9	16	57385	1888	12	13	4	2	2	.	..	1	2	1	..	2	2	..	..	1
February	29.9331	29.907	30.408	28.809	14.10	7.6	20.6	—13	44	77.0	2.208	716	28	10	12	5.545	12	15¼	776484	22.3	32	51465	7477	9	13	3	4	1	.	..	1	2	..	4	3	1	..	..	..
March.......	29.9120	29.821	30.611	29.260	25.80	20.2	31.4	— 3	46	80.9	3.849	361	28	1	15	3.945	12	19	650159	17.5	17	45388	3897	11	10	6	4	2	1	4	..	4	1	4	3	1	..	..	..
April	29.8251	29.726	30.433	28.906	30.40	24.3	36.5	10	55	71.6	4.020	244	28	..	12	5.320	8	20¾	702041	19.5	44	48704	2461	14	5	4	7	5	1	2	2	4	1	9	2	1	1	..	..
May	29.9147	29.755	30.364	29.014	41.00	34.0	48.0	22	72	69.1	5.587	51	12	..	11	3 145	..	..	677480	18.2	26	39024	6266	6	7	9	9	5	.	8	..	..	..	3	4	..	.	1	..
June........	29.9377	29.666	30.325	29.482	54.50	48.0	60.3	34	81	71.1	8.403	...	1	..	12	6.057	..	..	569780	15.8	12	34600	8000	11	7	11	1	5	.	3	..	..	..	..	1	..	1	..	..
July	29.9572	29.574	30.227	29.663	61.75	54.5	69.0	36	89	70.8	11.257	...	..	..	6	2 122	..	..	485820	13.0	..	30740	610	13	4	10	4	5	.	..	1	..	..	..	2	..	5	..	..
August	29.9455	29.409	30.259	29.619	64.50	59.0	70.0	46	82	71.0	12.610	...	..	..	11	3.428	..	..	568870	15.3	4	29260	8130	18	5	6	2	.	.	2	..	..	..	4	..	..	2	..	..
September ..	30.0065	29.649	30.355	29.531	58.00	52.3	63.8	36	75	74.0	10.593	...	..	..	18	6.956	..	..	648000	18.0	..	37530	8960	8	7	7	8	6	.	6	..	..	.	5	..	..	2	1	..
October	30.0214	29.848	30.550	29.218	44.00	38.5	49.4	25	67	71.7	6.179	24	12	..	14	7.745	4	4½	710334	19 1	16	57750	9500	11	12	4	4	1	.	..	1	..	..	4	2	1	1	..	..
November....	29.7621	29.639	30.445	28.954	35.10	31.8	38.5	23	63	77.2	4.661	95	23	..	16	5.700	8	7	869070	24.1	33	61410	7400	5	15	5	5	3	2	1	..	3	..	2	2	..	..	1	1
December	29.7009	29.640	30.552	28.813	25.60	21.6	29.6	7	39	77.2	3.067	324	30	..	15	5.120	12	17½	713920	19.2	44	98900	8600	11	9	7	4	.	1	2	..	3	..	..	2	1	..	3	..
Mean	29.8854	29.6924	......	......	39.29	33.64	44.84	..	..	74.3	6.233	...	..	..	12½	4.979	..	....	675908	18.5	..	.....	...	...	...	.	..	....	..	..	..	..	..	.	..	..	..	..	..
Extreme	....	......	30.611	28.809	.....	..	....	—13	89	....	.....	2486	193	15	152	59750	65	94½	8110903		44	61410	610	129	107	76	54	35	5	28	6	18	3	35	23	7	12	6	2
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1867. COMPARED WITH THE ABOVE.																																							
Mean	29.8524	29.6704	......	......	40.06	34 17	45 95	..	..	72.87	6.194	...	..	.	12	4.841	..	...	643534	17.6	..	Revolutions taken at 12 hours.	....	...	...	...	...	....	....	..	..	..	..	..	..	..	..	..	..
Extreme	....	......	30.768	28.676	.....	....	....	—10	85	....	......	2171	172	7	147	58.090	52	125	7722414	....	44		277	122	114	54	75	36	17	25	5	23	5	26	16	3	9	6	0
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February.

In February the greatest variations in pressure and temperature were observed. On the morning of the 5th the barometer stood at

30·371; during the following night the temperature fell to eight below zero, five inches of snow fell in almost a perfect calm, the anemometer only recording 18 miles in 14 hours. Suddenly the wind came round from the N. W. to the S. E., the temperature rapidly rose, the pressure rapidly decreased and that so quickly that in 24 hours it had fallen 1.562 inches. This great fall of the barometer was succeeded by a heavy storm of wind and rain on the night of the 6th.

The wind travelled 726 miles in 12 hours, when a sudden gust broke the anemometer. By the time the windgage was repaired the gale had moderated and the wind veered round to the West, where it continued until the night of the 8th, the thermometer then going down to 9 below zero. Again the wind went round to the S. E. and blowed for 15 hours at the rate of 79 miles an hour, the temperature having risen during that time to 51° Fah. The thermometer on the night of the 9th not going below 42° Fah. On the 11th it was so calm, that the air only travelled 13·4 miles in 14 hours; the anemometer recording but 671 revolutions.

October gave the highest monthly barometrical mean,—29·848. The mean temperature of the year was below the average,—39.29° Fah. compared with 49·06 in 1867. February was the coldest month when there were 716 Fahrenheit degrees of frost; the coldest night was 13 below zero on the 4th; the warmest day was the 21st, when the thermometer rose to 44°. August was the hottest month, the mean being 64·5°; the coldest night was 46° on the 28th, and the hottest days 82° on the 4th, 11th, and 24th. The hottest day of the year, however, was on the 19th July, when the thermometer registered 86° in the shade. The temperature fell below zero on 15 nights, and during three months there was no frost, July, August and September. In June there was frost only on one night.

From the above it will be seen that we have neither the extreme cold or extreme heat recorded on the same parallel of latitude more inland. The relative humidity averged 74·3 per cent. The mean force of vapour was 6·233 millemetres. February furnished the lowest mean, 2·208 m., and August the highest 12·61 m., the latter equal to 49.55 inches of mercury. June 5th was the dryest day when the relative humidity was only 20. On the 20th August the force of vapour was the greatest, being 20·10 m., and on the same day the relative humidity was at 100 or saturation. Ninety-four and a half inches of snow fell on 65 days; none fell in May, June, July, August or September. The snow and rain together measured 59·75 inches of water, and this quantity would weigh 5980 tons to the acre. The average number of wet days in a month was 12½.

The anemometer recorded 8,110,903 revolutions, in the course of the year, equal to 162,218 miles, and a mean velocity for the wind of 18·5 miles per hour. July was the calmest month when the average was 13 miles per hour; November was the windiest when the average rose to 24 miles per hour.

On the 22nd November the mean velocity for the 24 hours was as high as 50 miles per hour. The winds prevailed for 129 days from S. to W.; 107 days from W. to N.; for 76 days from N. to E., and for 54 days from E. to S.

Fog was recorded only on 28 days, and thunder and lightning on 12 days. The drift ice came on the coast as early as the 7th January. Robins were first seen on the 6th April. Grey birds began to sing on the 8th April. On the 22nd April the first herrings were caught in Glace Bay. Frogs croaked on the 1st May. The white coltsfoot came into bloom on the 8th; and on the 11th May the first butterfly, "the Camberwell beauty," was seen.

Art. VIII. Notes on the Structure of the Nova Scotia Gold Districts. By Henry Y. Hind, M. A.

[*Read April* 13, 1860.]

The wide distribution of auriferous quartz in the form of beds throughout Nova Scotia, suggests a uniform origin extending simultaneously over many thousand square miles. Gold, however, is not confined to beds of quartz, but is found in slates without any quartz being visible, and there is good reason to suppose that it is distributed in exceedingly fine particles throughout many beds of quartzite.

The auriferous rocks which are worked in the Province bear a certain relation to a series of ferruginous blue-black slates which overlie them, several thousand feet thick.

As the ferruginous slates are easily distinguished, are unlike any other known rock in the Province, and possess immense thickness, they form an excellent clue to the locality where the underlying quartzite groups may be found, to the north or south according to the dip of the slates.*

No gold bearing leads are at present worked in the ferruginous slates, although gold-bearing leads have been found in them, as at Wine Harbour, where they are well exposed to view on the coast at low tide, and at Sherbrooke three miles below the village. The city of Halifax is in part built upon the slates, and fine exposures may be seen in some of the streets, and particularly at the railway station. These slates lie above the great mass of worked gold-bearing rocks, which are upwards of nine thousand feet thick, and consist of quartzites interstratified with thin bands of green and blue-black slate, numerous thin beds of auriferous quartz, and some beds of sandstone and coarse grit.

The summit of the quartzite series is characterized by thin bands of green and greenish slates, in which cubic pyrites is abundant. The lower portion is distinguished by blue-black, banded, and plumbaginous slates in which arsenical pyrites is nearly always present in greater or less quantities, as well as in the form of large crystals in the quartzites, and sometimes in nodular masses in the slates and quartzites.

Lower down in the quartzite series coarse sandstones passing into a grit holding grains of a blue hyaline quartz, occur at Mount Uniacke, at Waverly, and at the mouth of St. Mary's River. At the first named district the band is 380 feet thick, very coarse at the base, and gradually passing into a very fine sandstone weathering white; at St. Mary's it is very characteristic.

The sandstones and grits at this horizon are fossiliferous, and of great importance in determining the relation which one gold

* These slates occur in several parts of New Brunswick, forming part of the Quebec group, (Lower Silurian.) They are noticed on pages 147 and 154 of my Official Report on the Geology of New Brunswick. Fredericton, 1865. Gold has also been found in quartz veins in schists underlying these blacks slates in that Province.

district bears to another. Thin "chiastolite" slates are also found at the base of the entire series.*

Underlying the quartzite group is a gneissoid series, overlying beds of granite interstratified with hornblendic schists, gneiss and granite. The uppermost granitic beds hold masses of hornblendic schists, sometimes in such numbers and quantity as to make it a conglomerate. It also contains crystals of arsenical pyrites. Its bedded structure is well seen on the Halifax and Windsor railway about four miles north of mount Uniacke. The quartzite group lies unconformably upon the granitic series, and contact is visible for more than a mile at Sherbrooke. Hence, while the quartzite series is regarded as Lower Silurian, the underlying granitic group may be Huronian or Laurentian. No limestones have been found in any of the gold districts, but a thin band of blackish limestone is found near the summit of the black slate.

A close inspection of the granitic conglomerate, especially when roughly polished, as when used for building purposes, discloses besides pebbles and unworn masses of schist, small fragments of schist which would escape detection in rough blocks or on weathered surfaces. The granite used in some of the public buildings at Halifax often exhibits small masses imbedded, and numerous fragments of schist which appear to have originated from an underlying thick bed which probably may be seen *in situ* about three miles north of Mount Uniacke with the granite overlying it. The whole gneissoid series is a sedimentary deposit, but intrusive masses of igneous origin, and commonly distinguished by large crystals of felspar, exist in or near most of the gold districts, and near Halifax.

At Sherbrooke several hundred feet of the gneissoid series are exposed below the quartzite group and lying uncomformably beneath it. Intrusive granite has broken through the gneissoid series, and forms bold escarpments about two miles to the east of Goldenville.

In order to form a proper conception of the structure of our gold districts, we must suppose that much of the gold was deposited from oceanic waters simultaneously with the minerals forming the rocks in which it is found. At a period subsequent to the deposition of the ferruginous slates, the gneissoid, quartzose and slaty

* See Note at the end of this Article.

strata were slowly undulated and thrown into a series of roughly parallel mountain ranges, constituting the east and west anticlinals.

Denudation to the extent of several thousand feet probably occurred during the folding. At a much later period another folding supervened from east to west, producing the low north and south anticlinals with numerous extensive dislocations. The effect of these combined movements was to produce all over the country a large number of elliptical domes, as if a force from beneath had elevated detached portions of the country in symmetrical lines or ranges. Denudation always continuing, the caps or crowns of these domes were removed and the outcropping edges of the slates, quartzites and thin beds of quartz assumed at the surface the forms we generally find them to have at present in the gold districts, namely, that of long ellipses or semi-ellipses more or less regular. Whenever the dome-shaped elevations attained an unusually high altitude the whole of the ferruginous slates and the quartzites were denuded and the underlying gneissoid series exposed; thus apparently favouring the view that these are intrusive masses of granite, instead of the exposed edges of gneissoid strata, standing out in bold relief owing to the resistance they have offered to the denuding forces, which have worn away the more yielding slaty and quartzite series symmetrically disposed above them.

The thin beds of quartz, called lodes, necessarily partook of all the movements to which the strata with which they are associated were subjected, and their study in the field as far as their present arrangement is concerned becomes a question belonging altogether to stratigraphical geology.

Waverley gold district presents us with an excellent illustration of the structural geology of the gold districts of the Province. The strata at Waverley are arranged in the form of an elongated elliptical dome tilted over to the north. The longest axis of this dome has a course N. 85° E. The force which produced the anticlinal operated from south to north and was prolonged until it assumed the form of an overturn, hence on the south side the dips are much less than on the north side, and at the depth of four or five hundred feet the strata on the north side will have an overturn dip, and a vertical section would show the beds to have been thrust over in the form of a pot-hook or letter *S*.

At Mount Uniacke, the reverse of this arrangement occurs. The overturn is here to the south, and the dips to the north are at a low angle. The same disposition is seen at Wine Harbour and Sherbrooke. At Mount Uniacke, Wine Harbour, Sherbrooke and Waverley, the lower gneissoid series stands out in bold outline to the north or east, the auriferous quartzite series reposing on it.

The low north and south anticlinals giving origin to the dome-shaped arrangement of the strata, cause the denuded gneissoid series sometimes to appear as detached masses, and serve to increase the illusion that they are all intrusive rocks. An unbroken area of these lower rocks occurs for many miles near the height of land between the Atlantic and Bay of Fundy, but on either side of this axis the auriferous quartzite group and the ferruginous slates are to be found in regular sequences, and occasionally intrusive granites penetrate the series.

Dislocations are numerous in most of the gold districts, and in many of the cracks true veins are seated.

If no break or fracture had taken place in the strata when the low north and south anticlinal was in process of folding, West Waverley, as part of a gold district, would remain unrecognized. At the east dislocation or line of fracture, an upthrow to the extent of 570 feet took place, and five thousand one hundred feet west of this the upthrow at the west dislocation was upwards of 750 feet. Nor were these the only movements which resulted from the fracture, the entire country between the great dislocations, comprising nearly the whole of West Waverley, was moved as it were on a pivot or centre of motion; the thrust being to the north on the Lake Thomas side for about 520 feet, and on the west or Fishing Lake side, 180 feet to the south. The pivot or centre of the twist lay between areas 200 and 221.

Simultaneously with this oscillatory motion, the strata were squeezed from west to east in the form of an arch, causing an upthrow of the crown of the arch about areas 222 and 223 to the extent of fifteen hundred feet, and bringing the walls of the dislocations three hundred and seventy feet nearer to one another; that is to say—if no squeeze from west to east had taken place, the walls of the break would have been 370 feet further distant from one another than they now are.

The several movements which have led to the present structure of West Waverley may be recapitulated as follows :—

1st. The great East and West overturn anticlinal.

2nd. The low North and South Cross anticlinal, which produced a fracture in the strata 5100 feet from one wall to another, as well as—

3rd. An upthrow of 570 feet on the east side, with a shove to the north of 520 feet, and on the west side an upthrow of 780 feet, and a shove to the south of 180 feet.

4th. A squeeze of the strata between the walls of the break to the extent of 370 feet, by lateral pressure, probably from west to east, and causing—

5th. An upthrow of the crown of the arch, resulting from the lateral pressure, to the extent of fifteen hundred feet.

The west dislocation is sharp and well defined, the line of fracture dipping easterly at an angle of about 60 degrees. The east dislocation is distinguished by a broad belt of disturbed strata, the rock having a brecciated structure. The barrel quartz of Laidlaw Hill, if it had maintained its dip undisturbed to a point 600 feet west of the centre of the bridge, ought to be about 500 feet below the surface on the axis of the anticlinal, and dipping westerly at an angle of 25 degrees; it is, nevertheless, found at the surface in a vertical position, or nearly so, with a strike S. 79 E. Throughout this broken belt, which may be 200 feet broad, the rock is much disturbed, the irregularity being caused by the grinding effect of the combined upthrow and shove to the north.

It may be described as a 'breccia' or rock composed of angular fragments cemented together.

Low down in the quartzite group fossil forms are abundant. They are seen on the weathered surfaces of the grits and coarse sandstones, rarely in the interior of the strata, although casts resembling a modiolopsis have been found in the quartzites as well as obscure stems of encrinites, and worm tracks. The most remarkable forms are found in the gritty sandstones at Waverley. Similar forms occur at Gold River, Sherbrooke, Fifteen Mile Stream, &c.

The occurrence of strata possessing specific characters in different districts many miles apart, enables us to identify the groups of leads or beds of auriferous quartz associated with them, and as a consequence, possessing probably considerable economic importance, we may eventually be able to predicate with certainty the existence of groups of auriferous leads in districts where no evidence is visible at the surface that such auriferous beds of quartz exist there.

As an illustration of this probable identity, in other words of the continuation of the same strata over a vast extent of country with their associated auriferous beds or leads of quartz, the following may be cited.

Beds of sandstone several hundred feet thick, and holding peculiar concretionary and supposed fossil forms, have been identified at Mount Uniacke, Waverley, Gold River, Sherbrooke and Fifteen Mile Stream. The distance between Gold River and Sherbrooke is 120 miles in an air line. The precise relation which this belt of sandstone bears to the summit and the base of the series is now known. At Sherbrooke the gold bearing quartzose series is not less than seven thousand feet thick, and the concretionary sandstones lie about sixteen hundred feet above the gneissoid series. Nearly all the worked leads at Sherbooke lie below this great mass of sandstone. At Waverley nearly all the important worked leads lie above it. At Wine Harbor the worked leads are wholly above it, and leads are worked in different districts in a belt of the quartzite group six thousand feet thick, thus showing the wide-spread distribution vertically and horizontally of the beds of auriferous quartz.

NOTE.—Since the above was in type, I have received the subjoined remarks from Mr. Billings, to whom I sent some specimens from the Sherbrooke Gold District.

" *Casts.*—These have the form that would be made by an *Orthis*, almost the size of *Orthis pectenella*, Conrad: some of the cavities have one side flat and the other convex, which would answer very well for the species cited. In one of the cavities there are several radiating ridges corresponding to the ribs of *O. pectenella.*

" These appearances are not sufficient to enable me to say positively that the impressions are of organic origin, while, at the same time they prevent one from asserting the opposite opinion, i. e. that they are not organic.

"No. 5.—I think this is an *Eospongia*, but as it does not show any minute structure, will not say so positively.

"No. 2. Which is no doubt the "Chiastolite" mentioned by Dr. Dawson, (Acadian Geology, 2nd Ed. p. 620,) appears to me to have been important, for the reason that it occurs in the gold-bearing leads of Australia.

"I showed your specimens to Mr. Selwyn, and he says the mineral has exactly the same form as that which occurs in the Australian rocks holding the Quebec graptolites. It is always found there in the vicinity of the granitic or gneissoid rocks. He does not think it to be Chiastolite proper, but whatever it may be, it is, in his opinion, the same as that of Australia.

"*Eospongia* occurs in the same horizon in Canada, and thus we have a concurrence of two facts which seems to throw some light on the age of the rocks of your district."

ART. IX. METEOROLOGICAL OBSERVATIONS AT HALIFAX, N. S., DURING THE YEAR 1868. BY FREDERICK ALLISON.

[*Read May* 10, 1869.]

January. In its clouding the first month of the year preserved its average mean. The whole quantity of precipitation was large, being chiefly in the form of snow which fell to the depth of 21 inches; though, besides the rain storm of the first night of the year we had two others. The range of temperature was not great, neither the maximum 38° nor the minimum—5° being extreme figures. The whole month was, with very little exception, intensely cold; and the mean fell below the great cold of January 1867—that month was 19°.10, this 18°.2—which is the coldest I have ever recorded in Halifax, and 3°.43 below the average of 6 years—4 times the thermometer marked below 0,—giving the same number as in January 1867. N. W. wind prevailed as customary and the mean estimated force was great, 2·8. Two gales were recorded; that on the night of the 1st, from S. E. being the heaviest. The other occurred on the 22nd morning and blew from N. E. to N. There was neither fog nor Aurora Borealis in January, and hoar frost but thrice. Sleighing was enjoyed in the city on every day in the month; and almost always very good.

February. This month also gives a result in mean clouding close to the average. The rain fall was not great; but snow was fully up to the usual depth, and would appear to have been more abnormal than it in fact was, were we only to consider the two preceding years, which were themselves extremely deficient in February snow. The remarkable severity of the winter showed no signs of abatement as yet; the mean temperature of this month being 18°.7—which is 6°.41 lower than in 1867, and 4°.62 colder than the average of 6 years. A wide range of temperature was attained, owing chiefly to the very low minimum,—11°. The maximum was 47°; and on eight days the thermometer marked below 0; five of these days, viz: from 22nd to 26th inclusive, being consecutive. Again was N. W., wind prevalent, and with the great mean force of 2·9. There was however but one gale, and that not of long duration. It blew principally from S. Neither fog, aurora, nor hoar frost was recorded. The sleighing was very good throughout February.

March. The estimated March clouding was near the ordinary amount. Though the precipitation was distributed over 18 days, the total was very small, both of rain and snow, of the latter but 4½ inches (dry) fell. This is less than one sixth of the snow in March 1867, though that month was as remarkable for snow depth as this was for the want of it. A wide ranging thermometer is again to be noticed from 56° to 2°. This minimum was on the 2nd; after which date the thermometer fell no more below 0 during the year we are considering. The mean temperature of this month I found to be 29°.3, which is ·89 above the 6 years mean, and 2°.36 warmer than in 1867. Still the wind from N. W. predominated, and with a strong mean force. A short gale from E. blew during the 21st afternoon: this was the only gale of the month. We had sleighing on the first nine days; 4 fogs, 2 hoar frosts, and 4 auroras were noted. The harbour was caught by frost on the morning of the 2nd to below George's Island, but not so as to prevent navigation, and the skim of ice broke up rapidly. There were also some parts skimmed across, above the Island, on the mornings of the 26th and 30th, but the rising sun soon removed all traces of these frosts. Robins were seen in the clearings near Windsor on the 23rd, which was also the day of their first appearance in that neighborhood in 1867; but this year, as in that, their general coming was not yet. Wild geese, bound N., passed over Halifax on the 24th, and next day a flock was seen flying nearly W. On this latter day I noticed them for the first time in 1868, and we find their arrival here not to vary much from this date in general.

April. In this month we shall see that its brightness, though greater than usual, does not imply either great freedom from precipitation, or much heat. Rain fell in fair quantity, and the fall of snow was excessive, measuring 14¾ inches, dry. April 1867 was somewhat cool, but this April was 2°.33 below the average mean, which is 37°.76. The range of temperature was not very extensive as the thermometer never registered above 58° which is a very small maximum. The minimum was 10° on the 6th day, an extraordinary degree of cold for the season; which may be inferred from the fact that in 1867 it was not marked later than the 16th of March, and in 1866 than the 9th of that month. W. winds slightly prevailed; and the coming spring was most plainly noted this year by the decline of the winter N. W. wind, over which W., S. W. and S. E. all triumphed. The mean force was again excessive; and we had the unusual number of 3 gales; all occurring, however, before the end of the 9th day. On the 5th and 6th there was tolerable sleighing in the city. I recorded 5 fogs, 3 hoar frosts, and 4 displays of aurora borealis. In the forenoon of the 10th a very plain Solar Halo was visible. Peach blossoms at Gorsebrook opened on the 2nd. On the 17th the Dent de Leon was abundant. Full bloom Mayflowers were picked near this on the 19th and at Windsor on 20th. Though this latter date agrees exactly with 1867, it was late in both instances. Smelt in the Avon were a week later than last year—in 1867 on the 15th, and in 1868 on the 22nd—and fully that time behind their ordinary date of arrival.

May. Both cloud and precipitation were again in excess this May, as they were in 1867. But 12 days were entirely dry, and 6.38 inches of rain fell. A few flakes of snow on the morning of the 6th were the last of the season. The range of temperature was extremely wide: from 23° on the 4th up to 78°.5 on the 15th. This maximum was high, though it has been exceeded in May; but the minimum is unequalled, except in 1867, when precisely the same figure was marked on the fifth. The mean temperature—48°.69 was nearly a degree warmer than in 1867, and .95 above the average. S. E. winds far surpassed those from any other direction, and were very nearly equal to the aggregate total of all others. May is a month of great variation in winds, but S. E. is a common direction. It may be remembered that the same wind prevailed in this month in the year immediately preceding that under consideration. The mean force was not great, and there were no gales: while many days were almost calm. An extraordinary quantity of fog visited us this May. We had frost on six mornings, which is considerably more than usual, but there was none between the 12th and end of the month. No hoar frost was deposited. But one aurora borealis was seen. No thunder nor lightning. One Lunar Halo was recorded, and a remarkable Solar Halo on the 3rd with the primary colours seen well. Hail fell on the 9th. All blossoms were late. Daffodils blossomed on the 18th. In 1867 these bloomed on the 3rd; and in 1866 on 22nd April. The wild cherry was in flower on the 25th; and the Narcissus not before 31st; having blossomed on the 28th in 1867. In Windsor also the May blossoms, such as violets, Pyrus Japonica, and Auriculas, were all more or less behind hand, A Humming Bird was noticed in that locality on the 28th.

June. This was a much more cloudy month than usual, and very wet for the season, 5.18 inches of rain falling. More than half of this quantity fell in the storm of 12th and 13th, which, for this month, was remarkably heavy. The mean temperature 59°.2 was .49 or nearly half a degree warmer than in 1867; but the average mean of June for 6 years is more than a degree above this, viz: 60°. 23. This early summer time gives generally a wide-ranging thermometer, and this year rose from 35°.2 to 83°.6 at 5 feet from the ground. On the grass, hoar frost formed on the 3rd and 4th mornings—the mercury standing at exactly 32°. This was the last frost of the season. In 1867 it came as late as the 11th and in 1866 there was none in June; while in 1865 hoar frost was deposited as late as the 15th. The common summer wind of this neighborhood S. W. prevailed; with an estimated mean force of 1.9—much below last year. We had thunder on 2nd, and 8th, and lightning on 8th and 22nd, aurora on the 10th and 15th, and a solar halo on the 11th. Again no gales. Fog was present on 9 days. Though the blossoms on fruit trees, and of many other plants, were still late, those flowers which depend more upon a mild moisture than upon the sun's direct rays had fully recovered the days lost at the beginning of spring. For instance the lily of the valley, which loves the warm shade, flowered on the 1st June, where it delayed till the 5th last year. Ordinary pear trees and plums bloomed on the 1st and apples not till 13th June; while in 1867, which was a decidedly late year itself, the pear blossomed on the 30th May and the apple on the 9th June. The horse chesnut, lilac, and hawthorn, blossomed on 15th 18th and 22nd respectively, against the 12th 14th and 23rd in 1867. Ripe strawberries were plentiful here on 26th; last year not till 29th. Inland they came from 3 to 5 days earlier. Comparing Windsor with the above we find tulips 1 day earlier there. The hawthorn 13 days earlier. The horse chesnut 1 day earlier. Lilacs on the same day and honeysuckles 4 days earlier. Nearly all flowers were much later than usual there; and shad did not strike up the Avon till the 20th. I insert these details at the risk of being wearisome; but no meteorological record is complete without comparing effects with causes, as the seasons revolve.

July. The mean cloud of this month was close to the average, and its general features were fine and seasonable. Rain fell but on parts of 10 days, and measured only 1.02 inches; and nine-tenths of this quantity fell on two days. A striking variation from last season. The range of temperature was not very great. The maximum being 87°.4 and the minimum 45°.9. The former is about the average; but the latter low, though in this respect there has for three years been scarcely a change. No whole day, however, was very cool, and the month's mean temperature was high, being 56°.53, or 3°.96 above the average mean of six years. Still the S. W. wind prevailed and blew for nearly half the month. The mean force being very gentle, showing another great difference between this and July 1867. Twice we had thunder and lightning; and twice the aurora borealis. Once a lunar halo;

and on parts of 8 days fog, but never continuous for more than a few hours. On the 3rd the Scotch rose blossomed; green peas were in market on the 4th, being the very same day as last year: three days later than in 1866, and ten days later than in 1865, 7th the bush bean flowered. Cherries were ripe on the 11th, last year they were one day later. New potatoes were dug near this on 14th, same day in 1867. In several parts of the Western Counties they came from 6 to 11 days behind us. Wild raspberries ripened here on 22nd. In 1867 on 23rd. Blueberries were ripe in each year, on 31st. Comparing 1866 I find these fruits maturing about the same dates, but in 1865 they were from 10 to 14 days earlier.

August. The improvement which July 1868 presented over that month in the preceding year was continued in August though not to so great an extent. In itself, however, the month was remarkably pleasant. The estimated mean cloud was 5.7. A rain fall of 3.6 inches was precipitated on 14 days: or rather 12 of measurable depth. This is below the average fall. On two days the temperature rose to the very high mark of 89°, which was the maximum of the year, and 1° above that of 1867, which also occurred in August; the minimum was 40°.8, to near which degree it usually falls, though last year not reaching to within 6°.4 of this—we had in consequence an extensive range. The mean of the month 65°, was 1°.55 above the average, but 2°.82 less than August 1867 which was a very hot month. Still I record the S. W. wind as prevalent, though very closely followed by S. mean force same as usual. Distant thunder was heard twice—aurora borealis seen on three nights—lunar halo once—fog on 10 days, but never through the whole day. A remarkable shower of meteors fell on the night of the 10th, towards the south. Some very heavy dews occurred towards the end of the month. Currants ripened on the 1st, one week later than last season. Indian corn on the 17th, fully ten days earlier than usual. It may be noticed that the bright dry July, and warmth and moisture during the first part of August seemed favourable to maturing this useful plant. In Windsor the harvest apple was ripe on the 19th, and the Madeline pear on the 22nd. These dates were exactly reversed in 1867. Blackberries were fit to pick on the 23rd, 6 days behind last year; and the musk melon was still later, not attaining a fair size till the 27th; while gooseberries were quite ripe in the same place on the same day as last year—the 9th. Nectarine plums were picked in Windsor on the 27th, against the 23rd in 1867, and the gladiolus blossomed on the same day.

September, usually one of our clearest months, was distinguished in 1868 by cloud in great quantity. The rainfall, which has been large ever since 1865, was again considerable and measured 5.55 inches. This September was also exceptional in its mean heat, which ran up to $59^{\circ}.47$, being $1^{\circ}.73$ above the average mean, and warmer than any one of the six recorded. The range of temperature was rather more contracted than usual, extending from $80^{\circ}.4$ to $33^{\circ}.8$. This maximum is about the ordinary mark, but the minimum is frequently two or three degrees lower than this. On the grass 32° was first registered at 5 o'clock on the morning of the 18th; so that this summer the index remained above the freezing point for 106 consecutive days, viz., from June 4th to September 18th. In 1867 this period reached only from the 11th June to 12th September—93 days. The averagé will be found between these two. In winds also the usual September course was departed from, as those between S. W. and N. W. generally predominate; but this year, though N. W. were common, S. were still more so, and S. E. prevailed over all. The mean force was not remarkable in any way. Fog occurred on parts of 5 days—the aurora borealis on 2 nights only. Hoar frost twice. I may here state that near Windsor hoar frost was deposited as early as the 3rd. Four times was thunder heard, twice attended by visible lightning. Tomatos and blackberries ripened at Windsor on 3rd. Maria pear, green gage and Washington plum at Windsor on 10th; coming in 1867 on 9th 18th and 12th respectively. The bon cretien pear was ripe in Windsor on the 15th, instead of the 13th as last year. Damascenes were picked ripe on the same day, and the Gravenstein apple on the 24th—both at Windsor. At Gorsebrook the tomato ripened on the 10th: the Orleans plum on the 14th: and peaches on the 26th. All fully beyond their average season.

October. The large amount of clear sky in October, amply compensated for a cloudy September. The days marked by precipitation were not many—being 12 in all—but the total of rain and snow measured the considerable quantity of 5.89 inches, on account of several heavy falls of the former. 2.5 inches of frozen snow were deposited, giving when melted .26 inches or about the average proportion. This snow came in two falls on the night of 17th, and early morning of 22nd. The latter was quickly washed away by succeeding rain; but the former, which measured on the level 1.5 inches, and drifted in some places to 7 inches, will be readily remembered as a remarkable storm for such a date, and the first of the Autumn. In 1868 we were without any snow falling from 6th May to 17th October—164 days. In 1867 this period extended over but 156 days—from 28th April to 1st October. But one morning was foggy. The range of temperature was excessive; from 74°.7 to 19°. Both maximum and minimum beyond any previous one of my records for this month. On the whole October was cold. The mean 44°.31 was below the six years average, which is 45°.98; and was also below any one of the five years immediately preceding. Water was first frozen on night of 17th. This happened on the 4th last year. With the approaching winter N. W. wind again asserted itself, and prevailed. Currents from S. to W. were very common, however. The gale from N. N. E. to N. W. on night of 17—18, was the only one this October. Being generally a windy month, the mean force 2.3 cannot be considered great. On 5 nights the aurora borealis was visible. Thunder and lightning twice; and hoar frost on 5 mornings. Common meteors were observed falling on the 11th and 23rd, and a lunar halo on 24th. Capiauman pears were ripe in Windsor on the 3rd. The cycle, Marie Louise, and Flemish beauty all on the 5th. These were all somewhat late, and the first named pear particularly so; so that the fruit season of 1868 corresponded in tardiness with its time of bloom. Thus in 1865 the capiauman was ripe on September 16th; in 1866 on September 27th; in 1867 on 4th October, and this year on 3rd. And the other fruits bear much the same relations.

November. The cloud of this month in this latitude is generally abundant, but in 1868 did not reach the average, and was considerably short of 1867. The days of precipitation numbered 14, and the depth of rain and snow was excessive; being 6.45

inches, and the greatest of any month this year—.07 more than in May. By far the largest portion of this fell as rain. The snow, though not equal to last November's fall, was however found to contain .4 inch of water; dry, it measured 4 inches. This was an extremely cold month—the mean temperature, 34°.77, being 1°.83 below the cold November of 1867, and 3.87 colder than the average of six Novembers, the range was, however, wide, on account of the maximum marking up to 66°.8. The minimum, 15°.5, was rather low; but we have reached 13° in two former Novembers. N. W. wind prevailed as usual, though winds from almost every quarter are frequent in this month. The mean estimated force attained the high figure of 2.9. But one gale visited us, and that was a cyclone on the 27th; first striking us from the customary S. E. and swinging to N. W. in the afternoon. The other phenomena were two auroras, five hoar frosts, one lunar halo—rainbows on the 6th. There was neither thunder nor lightning. Four mornings were foggy and one afternoon. First skating on the 16th; and we had sleighing on one morning the 23rd: this occurred last year on the 20th evening, lasting 4 days.

December. December was finer in every respect than the last month. Without the brightness of December 1867, it was still not very cloudy for the time of year, and in other characteristics was much more pleasant than that month. The total precipitation was small, though scattered over 14 days. The greatest deficiency was in rain, there being but 1.39 inch; while snow was above the average, falling to a depth of 20.5 inches, and when melted making 2.19 inches. Thus the whole amount of water measured 3.58 inches. There was some fog on two mornings. The month was rather mild, but the difference between its mean temperature and that of six years is very slight—the one being 24°.98—the other 24°.84. This moderate weather was also very steady; the maximum being 43.°8, and the minimum being 1.7—so that the thermometer never registered below 0. This has not occurred since 1863. Again was N. W. wind prevalent; far surpassing any other. The mean force, 2.1, has not been so small for several Decembers. Two gales were recorded, the one on the 7th and 8th cyclonic in its character and very strong in its earlier hours—the other a straight blowing N. W. gale, with gusts of varying strength. But once was the aurora borealis visible, five times was hoar frost deposited, one lunar halo was seen. Also one rainbow. Sleighs were used in the city on 16 days. There was good skating at Dartmouth on the 7th. Last year this happened on the 5th.

REVIEW OF THE YEAR 1868.

Though I fear my audience may already have had a surfeit of statistics, it may be useful to consider very briefly 1868 as a whole.

The mean estimated clouding, then, amounts to what may be usually expected in Halifax—6.57. In 1867 the corresponding figure was 6.38. (It will not be forgotten that in my form of observations 10 signifies complete cloud). The year, beginning much as usual in this respect, fell steadily towards greater clearness for the first four months. A great and sudden increase was then noted in May; and the next month still exhibited a high number, though falling gradually till September, when again the amount increases to exactly the May limit. But October shows another rapid change, and marks the brightest period of the year. Then rising once more in the scale, through November we close the year with the month of greatest clouding. In 1867 the least and greatest amounts of cloud were obtained respectively in June and November.

In precipitation we arrive at the following totals and means. The whole number of wet days, i. e., of days on which precipitated moisture was measurable, was 187. Though this is much less than in the extremely wet year of 1867, it is still rather above the average. In the guages the total rain measured 41.8 inches, and melted snow 8.17 inches; together 49.97 inches. An amount somewhat larger than usual, though still less than in the preceding year. The depth of frozen snow in 1868 was 81.4, which gave the water equivalent above mentioned. It is believed by some meteorologists that all phenomena in their department of science proceed in periods of increase and decrease—undulations, as it were, rising and falling during series of years of approximate duration. Be this as it may, we appear in 1867 to have reached the culminating point of a period of moisture which had been on the increase for at least five years. In 1868 we began to descend. The year commenced with tolerable dryness, which was particularly noted in March; but through April's snow the precipitation increased, and in May the rain fall was very great. The amount declined gradually in the next month, and in July was marked the minimum. Again rising steadily, month by month, we reached in November a maximum of precipitation (but a trifle above May, however), and then dropped suddenly below the average in December.

Now let us for a few moments consider the mean temperature of last year, before noticing the details of heat for that period. That mean was decidedly a low one; being 42°.12—or 1°.02 less than fhe average mean heat of 6 consecutive years in Halifax. The difference of 1° degree of temperature in a year's mean may strike the casual observer as trifling, but it is by no means so in reality; and all will recognize it as an important variation, when they remember the external tendency to equalization in all the phenomena of every climate. A tendency absolutely necessary to enable the same districts to produce the same vegetation in more or less perfection, and abundance, each season. The importance of an apparently slight difference will be also better understood, when the large number of observations from which a year's mean is deduced is borne in mind. In temperature this number is 4.380. Though as has been stated, 1868 was a cold year, it was .14 warmer than 1867; which latter was a turning point in temperature, as well as in precipitation. The monthly mean temperatures in 1868 rose above or fell below their averages as follows. The comparative terms I am now using of course apply to the relations between these individual months and their predecessors. The year began very cold, growing still more so till March, which was rather warm, but April again was cold, though in May we rose a little above the average. In June it fell cool again, but July was decidedly the warmest month, and August and September, though not so warm, kept well above the average. A sudden fall took place in October, and continued during November, which was the coldest according to season of any except February. December was warmer and the year finished within a very small fraction of the average heat. Regarding other features of temperature. The maximum was high, viz: 89° on 4th and 25th August. In 1867 it was 88°—on 10th August. I have not recorded as yet a greater degree of heat than this in Halifax; but our late worthy member and esteemed friend Col. Myers marked 92° on 15th June 1864; though I recollect that that gentleman himself did not place much reliance in the complete accuracy of his self-registering thermometers. – -11° was the minimum of the year, obtained on 4th February. In 1867, –9°.3 was the minimum; and –15°.7 is the greatest cold recorded in Halifax during 6 years. We had thus in 1868 a range of exactly 100°; a wide one for this station.

Besides adding to my stock of instruments, a very satisfactory form of rain guage during the past year, (which I should more properly have alluded to under the head of precipitation), I have paid more attention to the direction and estimated force of winds, though still without an anemometer. The results of these observations I now present in brief. Dividing the compass into the eight chief points, I find the N. W. wind by far the most common, prevailing on 83 days out of the 366. Between S. W. S. S. E. and W., there was not much difference—their scores being respectively 61, 55, 52, and 51 days. N. followed not far behind with 42 days; leaving but 13 days for the N. E. wind, and only 9 for the last of all, the E. Looking at the collected months, N.W. was emphatically the winter wind, prevailing during January February and March, October, November and December. S. W. occupied the summer months of June, July and August. S. E. while the heat was increasing, and declining, in May and September. And W. was the principal direction of April, In force, it is to be noticed that 1868 opened with a high figure; increasing, with the exception of a small drop in March, till May, when it lessened sensibly, holding its own through June, and again falling in July, when the least mean was recorded. Then a steady rise took place, till in November the force was unsurpassed, though equalled by February and April. In December we fell back to the September mean, closing with a figure below the average of the year, as a whole, the mean force was 2.31. Continuing the inquiry of 1867 to this year, and separating the winds into those between N. W. and S. W. on the one side, and N. E. and S. E. on the other, and excluding N. and S., I find 195 of the former, or westwardly, and 74 of the latter, or eastwardly winds. So that the first exceeded the second by 164 per cent. In 1867 the ratio was very near this, being 155 per cent., though the numbers of each were considerably greater. In January I recorded 2 gales, February 1, March 1, April 3, then none till October when 1 was noted. In November 1, and in December 2, making 11 in all. It would require a paper in itself to enter further into this branch of meteorology. For, as heat is the active agent and the atmosphere the passive agent, the direction and strength of air currents are the most important effects to be studied in this science. I only mention now that of these gales at least 8 were cyclones, of which 4 struck us first from S. E., 2 from S., 1 from N.W., and one from W. Of the 3 of which I have no other proof, than that they were straight-blowing winds, 1 was from N., 1 from E., and 1 from N. N. E.

An unusual number of fogs visited us. In January 0, February 0, 4 in March, 5 in April, and the extraordinary quantity of 14 in May. In June 9, July 8, August 10, September 5, October 1, November 5, and December 2, making 63 in all, against 42 in 1867, and an average of 54 for the past 6 years.

On 27 mornings hoar frost was deposited, viz., 3 in January, 2 in March, 3 in April, 2 in June, 2 in September, and 5 mornings in each of the last three months of the year. In 1867 this phenomenon was noticed 32 times; and is generally more frequent than in 1868.

Thunder was heard without visible lightning 5 times; and but once was the reflection of the flash seen with no audible report. In all, thunder and lightning were observed 13 times, included between 2nd June and 17th October.

Distinct lunar halos were noticed 6 times, more frequent towards the close of the year, and solar halos on 10th April, 3rd May and 11th June. Hail fell twice, and twice were rainbows recorded.

We had frosts on 179 nights in 1868, and on 183 in 1867. The greater number being entirely due to the colder March of the last mentioned year.

In my paper read before the members of this Institute in May last, when speaking of the aurora borealis, I alluded to the probability of wet weather following close on these displays according to season; showing, from 11 years of records, that this probability in winter was as 3 to 1. In spring and in autumn, that dry weather was as likely to occur within the 24 hours as wet: and that in summer the probability was against wet weather as more than 2 to 1. In this place, I do not follow the rule for seasons, which we have adopted from England; and which for convenience sake is followed throughout the temperate zone of the northern hemisphere. But I divide the year more properly according to real characteristics of our Nova Scotian climate; calling spring the period from 15th April to 15th June, summer from 15th June to 15th September, autumn from 15th September to 15th November, and winter from the latter date to 15th April; though, of course, I keep to the old periods in my records, that they may fit harmoniously with the rest of the continent, and with Europe, when this station is connected, (as I hope it soon may be) with the outside world. Noticing that these relations of the aurora with precipitatiou were closely preserved in 1868, but that the wet weather would predominate over the dry considerably were the time extended to 36 hours; I now propose to shortly consider this phenomenon in connection with gales. I find that out of 95 exhibitions of the aurora borealis extending over every season, 61 were followed by no gale or very high wind—when on 34 occasions these were followed by winds of great strength, the first directions of these winds were very variable, viz., from N. 9, E. 1, S. 5, W. 1, N. E. 2, S. E. 5, S. W. 7, and N. W. 4, so that the theory that the aurora is invariably, or generally, followed by a southwardly storm has no foundation in fact. That these displays do indicate some great atmospheric disturbance is undoubted, as they are never seen when the weather is settled, and the temperature is equable; and it is after all in this great root of meteorology, viz., heat, that we must seek a solution of all atmospheric phenomena.

I think that the wonderful aurora of the 15th of last month (which by the way was not followed by either high wind or appreciable precipitation within 50 hours) gives evidence that this is not a purely magnetic phenomenon; as while the whole heavens were more or less illuminated, the brighest and highest coloured rays shot nearly at right angles to the poles. While from personal observation I cannot find the deductions contained in the following letter to be correct, I still feel bound to produce this evidence; which at least deserves respect on account of its age. (Read extract.)

I cannot close this paper without acknowledging the obligations under which I have been placed by several friends, and by some who were otherwise complete strangers to myself, in aiding the development of Nova Scotian meteorology, by valuable hint derived from their own experience in other countries, and by giving me access to useful instruments and books. Among the strangers to whom the Province is really thus indebted are our own corresponding members J. S. Hurdis, Esq., of Southampton, G. Murdoch, Esq., of St. John N. B., and Dr. Chas. Smallwood of Montreal. I have also to thank the proprietors of the *Express* newspaper who have for the past year most courteously thrown open their columns to my meteorological reports each month, actuated by their ever present desire to advance our native Nova Scotia. I have now only to hope that the efforts of this Institute to secure a meteorological observatory at this point may be crowned with success.

ART. X. THE WALRUS.* BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read May* 10, 1869.)

Trichecus, rosmarus, (Gmel.)

I beg to lay before the Institute, a description of a Walrus, that was brought to Halifax in April of the present year. It was shot in March at the Straits of Belleisle, Labrador—dragged on the ice for five miles, and then taken by ship to St. John's, Newfoundland, and from thence fetched to Halifax.

Extreme length, 12 ft. 3 inches.
Length of head, muzzle to hind part, 1 ft. 5 inches.
Muzzle in breadth, 1 ft.
External tusk, length, 1 ft.
Tusks, inside mouth apart, 4 inches.
Outside mouth, apart at lips, 11 inches.
Eye from nose, 8 inches.
From eye to eye, $9\frac{1}{2}$ inches.

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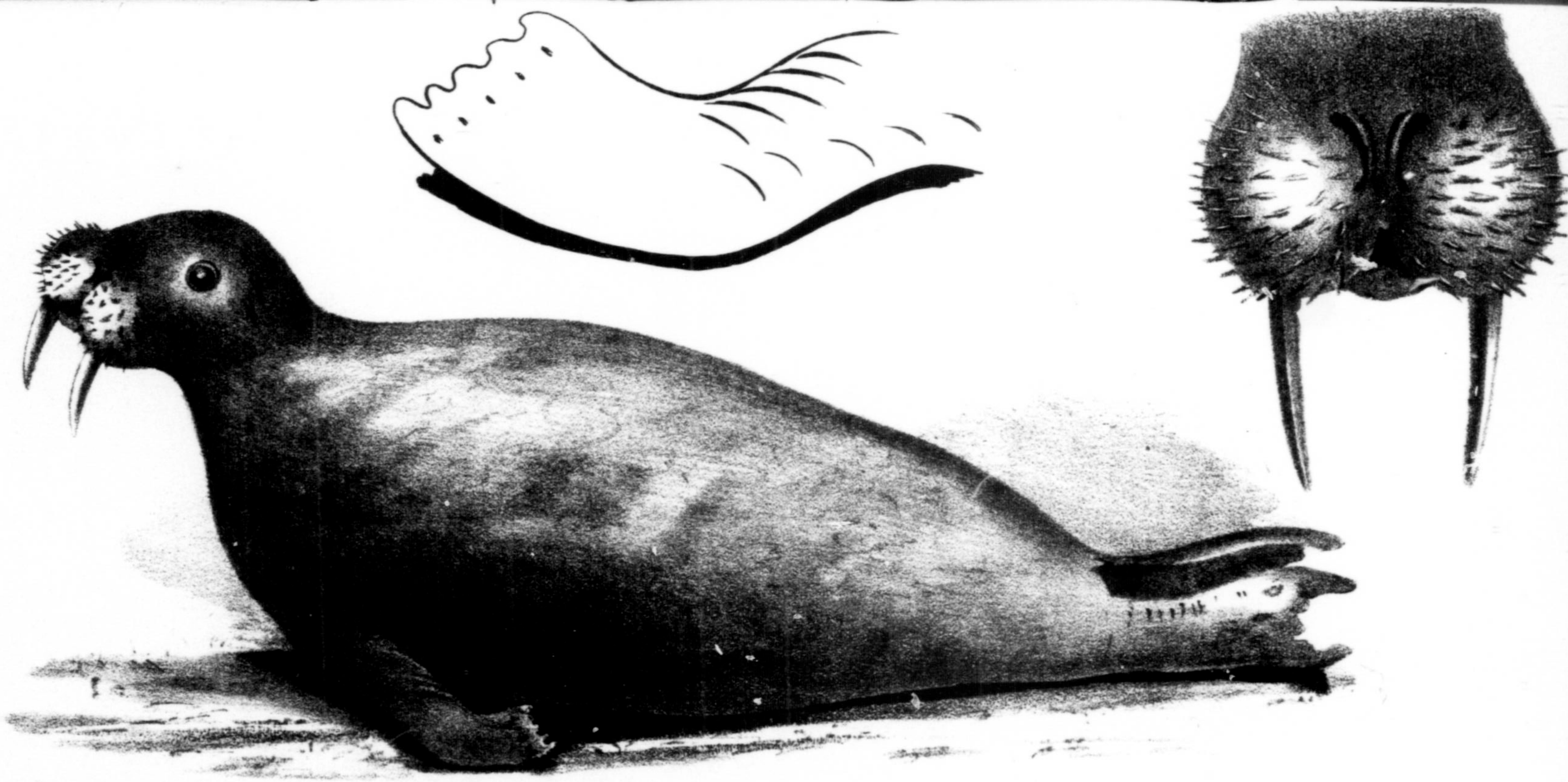
* In the plate accompanying this paper I have drawn the Walrus to a scale of half inch to a foot, I have also shown the peculiar crescentic nostril with its inner fold and the fore flipper with its five scalloped edge and rudimentary nails far above this edge. To Mr. Roue I am indebted for the many opportunities of sketching the Walrus he gave me, and to Mr. Clark for the lithographic plate, the first connected with Nat. History ever issued I believe in the Province.

Skin in thickness, 1 inch.
Blubber in thickness, $1\frac{1}{2}$ inches.
Fore flippers in length, 2 ft.
" " in breadth, 1 ft. 1 inch
Hind flippers in length, 1 ft. 10 inches.
" " in breadth, stretched, 2 ft. 6 inches.
Weight—said to be, 22 cwt.

In general appearance this animal had a comparatively small head, neck longer than a seal, with swelling breast and rounded ribs carried down about as far as in the ox. The body everywhere round, tapered away more rapidly below the ribs to the tail. It was covered by thin, and adpressed light yellowish green hair; when raised by a needle, one inch long. the surface of the entire skin was covered by scars, and bald warty patches, and lay especially about the neck and shoulders in welts and folds such as in old bulls, one often sees. The head was round and supported by a neck much longer than a seal, two tusks of hard sea ivory projected from the upper jaw, and diverged from four to eleven inches apart, at their extremities. Owing to the thickness of the upper jaws to receive the sockets of these tusks, and also to the thick upper lips from which the very peculiar moustache bristles protruded, the nostrils themselves were sunken below the surface. The nostrils were crescentic like two upright commas, with a peculiar crescentic fold inside of each, and between both, (which I suppose, acted as a valve in closing them under water.) The external ear was a small hole in a deep fold of skin. The bristles forming the moustache were very peculiar; they were two or three inches long, of the size of large straws but not tapering to a point, they were pellucid as amber, and of the same colour. I did not count them as evidently many had been rubbed off from friction in dragging on the ice, they had not that three-plied appearance noticed by Crantz and copied from him by future writers. Besides these peculiar bristles, there was a small curly moustache between the nostrils, and the lips were hairy, and inverted, carrying the hair a little way into the mouth. The eyes were imbedded in two fleshy prominences. From the animal having been dead for so long a time, I could not well make them out. They appear closed by lids though Crantz says they have no lids, and from the inner angle of the eye there was a third lid nearly an inch long, as it lay unextended. The



Clarke's lith, Halifax, N.S.

DRAWN ½ INCH TO 1 FT.

Dr Gilpin, Del.

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two prominences of the eye together with the two swelling and rounded upper lips, gave the appearance of the face being formed by four round prominences, as one sees in all the pictures that have come down to us from the earliest describers. There were four molar teeth in both sides of either jaw, making with the tusks, eighteen in all. In the upper jaw the crowns are worn very flat, the facets looking inwards with a slight ridge on the two posterior. In the lower jaw the teeth were worn to a ridge with their facets looking also inwards. In the upper jaw of an old skull from Sable Island the teeth are worn into sharp points. It is impossible to generalize from these facts so few and so opposite, yet it would appear that the action of the jaws was a direct up and downwards crushing without lateral motion. Cuvier remarks that the young have a fifth molar and four incisor teeth in both jaws which soon fall out. It seems they had disappeared in both these instances. The fore flippers were two feet long, the palms naked, warty and calloused. When stretched out about thirteen inches wide with the outside edge the longest. There was no division into digits, but five very rudimentary nails, two or three inches from the extremity and five scallops in the outside web, revealed the skeleton of five distinct digits within. The hind flippers were very round and fat with no external appearance of heel as in certain seals. They were twenty-two inches long, had the same five rudimentary nails, and five scalloped edge. The outer and inner edges were the longest, and the sole was black, naked and warty. There was no appearance of tail, but when skinned it seemed about two or three inches long, the rectum appeared like a large hairy sack, the pairs being carried four or six inches up the gut. This is analogous to the hairy lip, which has already been described. The pœnis was of bone projecting from a large sheath, but so evidently imperfect from being worn in dragging upon the ice, that a description would be useless. The skin was one inch thick, lined by a blubber or layer of fat one inch and a half thick. Thus we find the Walrus much nearer allied to the Cetæ than the seals are. His simple teeth—some scarce surviving puberty, resemble the rootless fangs of the cachelot, and his tusks come nearer to the single horn of the narwhale than those of any mammal with four extremities; the teeth of the seals on the other hand strongly resembling the complicated organism of higher terrestrial mammals. The extremities with rudimentary nails, far above the edge and not divided, approach the flappers of the cetæ which have no nails, and the edge simple, whereas in certain seals, the nails are perfect claws, extending below the edge, and the heel distinctly marked. The cetæ on the other hand, preserving the skeleton of five digits in their plain fore flippers, or fins, and in the flukes of their tail, carried in a plane at right angle with that of the body, instead of as in the true fishes, in one coincidental with it. The true fishes in the oblique setting on of their pectoral and ventral fins, retain almost the sole typical mark of their analogy with the highly organized four extremitied mammals. It is pleasant also in studying one of our extinct provincial species thus brought bodily back before our own eyes, to where centuries past they roamed in thousands, to notice how accurate the older naturalists have been in their descriptions. Fabricius seems to have drawn his descriptions from life, and Crantz, though the specimen I have described differed from his in having eye lids, and in the moustachial bristles being plain, has evidently left the graphic description of an eye witness. Brooks, 1772, writing of its hair—calls it mouse color, in some reddish, in others grey, and in others scarce any hair at all, and about the joints fall of lines and scratches. He speaks also of the semicircular nostrils, and the peculiar bristles, as thick as a straw, not, however, calling them three-plied. He also mentions their eye lids, and pœnis of bone, Brooks must have taken from the life his excellent description of this half naked, patchy, wrinkled aud scarred sea monster. The Walrus has long been extinct from our province. The latest accounts are those of Lord Shuldam, who I think will be identified with Vice Admiral Shuldam who served on the Halifax station, 1773—at that time they were numerous at the Magdalene Islands. At Miscou, Bay Chaleur, Perley found only their bones, but in such numbers, as to form artificial sea beaches. These were doubtless the victims of "The Royal Company of Miscou," founded during the earlier part of the seventeenth century, by the King of France, and whose ephemeral city of New Rochelle, numbering at one time some thousands, has passed away leaving no sign. The murdered sea horses have left a more enduring monument than their murderers. Though we have no accounts later than the seventeenth and eighteenth centuries of their inhabiting Sable Island, yet it is very probable that they continued to resort there until they entirely left these latitudes. Its difficulty of access, its being uninhabited, and its sandy bars fringed with a ceaseless surf, point it out as their last hold. Even yet a small representation of the great arctic sea herds yearly visit this Island. Sometimes in January, but more often in February, a herd of several hundred large seals make their appearance upon the N. East bar; if molested they re-appear upon the S.W. bar, where they remain if undisturbed the whole summer, they and their little ones—for they usually whelp in early spring. They are called characteristically enough, by the patrolmen ocean bulls, but I fancy are either *P. barbata*, or *H. gryphus*, or perhaps both, as Dr. Gill has certainly identified the great grey seal on Sable Island. I saw them there in June of 1854, but had none of them in hand. By galloping down upon their line of retreat, I was enabled to close upon them as they shouldered or hummocked themselves into the sea. The bristly moustache of the old ones, and the white and spotted coats of the pups, very much resembled the plates of *P. barbata*, whilst their size at once separated them from the common seal *P. bitulina* which constantly inhabit the island. This last deputation from the north, will doubtless, like the Walrus, and the great auk be pushed back by man to the frozen circle. It would be curious to trace what effect this deprivation of genial heat and high temperature, especially in the young must produce in the reproductiveness, the habits, and power of sustaining life or vigour in after life. If all created things wage a battle of life, it must be confessed that its tide has turned against these poor sea horses. Restricted to the high latitudes, deprived of the great enjoyment of basking, lying, and resting on the sun-heated sands, in latitude 44° N., (an enjoyment only comprehended by those who have witnessed it), they are pushed back to the ice floe, and damp fogs of the arctic circle. The food that fed their progenitors is strange to them. Are their numbers less? Are they of less dimensions? Is their layer of blubber thicker in the greater cold? Are they like their old companion, the great auk destined to become extinct of modern man? Who can answer?

ART. XI. NOTES ON THE ECONOMIC MINERALOGY OF NOVA SCOTIA; BY PROF. HOW, D. C. L., UNIVERSITY OF KING'S COLLEGE, WINDSOR, N. S.; PART V., COALS AND ALLIED MINERALS.

(*Read June 14th*, 1869.)

IT is proposed in the present continuation of these "Notes" to put together in a condensed form such results of the examination of the Provincial coals and other combustible mineral substances, as have been obtained with regard to their character, chemical composition, and economic value, and to institute comparisons between these and similar minerals of Great Britain and the United States, so far, at least, as the investigations made will admit of this course, for, owing to the various modes adopted in the analysis and practical examination of coals, any comparison of the kind in question must at present be very imperfect, and it will not be possible to show exactly the position occupied by the N. S. coals until such a systematic trial shall have been made of their qualities, as will bring out results comparable with those obtained in the enquiries instituted by the United States and Great Britain into the nature of coals suited for their respective steam navies. The first step in an investigation highly important, was taken by the former country, in the enquiry conducted at the Washington Navy Yard in the years 1842-3. It was obvious to a man of the discernment of Mr. Joseph Hume that such an example ought to be followed in England: he accordingly brought the matter before the Lords of the Admiralty in a letter from which I make the following extracts which can hardly fail to be interesting in this coal-enriched Province. "I am informed that no inquiry into the several kinds of fuel that might be used for steam engines, with the view of ascertaining what fuels have the greatest evaporating power in the smallest space and weight, has been instituted by any department of the Government, and therefor beg to recommend the subject as one deserving the immediate and serious attention of your Lordships. The efficiency of the steamers must depend on the quality of the coals and fuel used for the Naval Service, and, without an accurate knowledge of the power of the coals to be used, the country may be paying the highest prices for an inferior article;

and, depending on the power of the fuel, the public service may suffer disappointment at a moment when the greatest interests of the country may be at stake.

The late Mr. Upham of the U. S. was strongly impressed with the importance of determining the nature and qualities of the several coals in the U. S., with a view to their use in the steam navy of that country, and, in 1842-3, directed a course of experiments to be made on the different coals of the U. S., for the purpose of ascertaining their evaporative powers.

I have only this day received from the U. S. the report of that inquiry, and I have the satisfaction of sending a copy of that report that your Lordships may see the results. They have decided by direct and practical tests the comparative usefulness of American and English * coals, as well as the relative value of the former in their numerous varieties; and I submit to your Lordships that a similar enquiry should be instituted into the comparative usefulness of the several kinds of British coals with a view of ascertaining the best for the naval steamers of this country.

I may be allowed to point out to your Lordships that there is a public establishment perfectly qualified to apply the requisite tests, and one chemist of eminence may be added to assist in what is an object of great national importance."

The British Government ordered such an enquiry as was recommended: it was commenced in 1846, was carried on about 6 years, and the results obtained were embodied in three successive reports presented to Parliament by Sir Henry de la Beche and Dr. Lyon Playfair, who were entrusted with the superintendence of the investigations. Having been for about two years engaged as chemist I am familiar with the methods of examination adopted and naturally take considerable interest in all the chemical results brought out from time to time respecting the coals of this province. Although these are not, for the reason before given, altogether comparable with those obtained in the official enquiries, they are so to a certain extent, and more particularly with those of the U. S. investigation. It was the object in both countries to decide not only what coals were best for the purpose in question, but how far the practical results

* Three English coals only were tried against a large number from various parts of North America.

were in accordance with the amount of work theoretically possible in view of the chemical composition of the coals. The American fuels were subjected to proximate analysis which furnishes the relative amounts of moisture, volatile combustible matters, fixed carbon, and ash, while the British were made to exhibit not only these results, but, in a few cases, the amount of gas, tar, and other products, and in all, the relative quantities of their ultimate elements, viz., carbon, hydrogen, nitrogen, sulphur, oxygen (and ash). Now, as regards the coals of the province, several of them have been submitted to proximate analysis and the results of their examination are to be found in Dawson's "Acadian Geology," or in my late "Report to the Prov. Govt. on the Mineralogy of Nova Scotia." Some of the data obtained lead to certain conclusions with precision, and others are of approximate value as indicating the theoretical value of the coals, and thus enabling us to compare them to some extent with the fuels of the countries which have had the advantage of scientifically conducted practical inquiries. In addition, we have the results of such trials in the case of two N. S. coals made in the American enquiry, and one ultimate analysis of a provincial coal made for the Acadia Iron Company. Finally, a few of the coals have been tried in steamships, and so compared with others in a really practical way; affording results which are stated generally, and, of course, without the scientific accuracy attaching to those obtained in the enquiries under consideration.—(*Loc. cit.*)

Classification of Coals and Allied Minerals.—These substances are differently arranged by good authorities, especially as regards the varieties made of bituminous coals. There is not much diversity of opinion respecting the primary groups, viz., graphite; anthracite, stone coal, or culm; bituminous, soft, black, common, or pit coal; brown coal or lignite; peat; bitumen; and finally, shale or batt. When, however, the attempt is made to classify the bituminous coals, or to say what place such substances as are now generally called oil-coal for the sake of distinction, shall occupy, a very considerable range of opinion is observed. With reference to the first of these points—classifying common coal—Jukes says:—"*Ordinary or pit coal* has many varieties; indeed these are often as numerous as the different seams of a coal field, and even the different beds of a compound seam are readily distinguished from each other by the colliers who give particular names to them; and even small blocks of these varieties can be recognised by them, and identified with the seam, or part of a seam, from which they are derived. Neither are these distinctions, which are only to be perceived after long practice, unimportant, since these varieties have distinct qualities, some of them being better adapted to smelting, and said to be 'good furnace coal'; and some of them to blacksmith's work, or 'good shop coal'; others to various uses; while only a few, comparatively, are best fitted for domestic purposes, and are brought to market by the coal merchant." (Manual of Geology, p. 132.)

The variation in character throughout seams here alluded to is well shewn to be accompanied by diversity in chemical composition by analyses made of the coals of this province, all of which are "bituminous."

Thus, the two benches of the Haliburton seam at the Montreal and Pictou Mine give, by my analyses:—

	No. 1.	No. 2.
Volatile matter	29.35	25.40
Fixed carbon	61.07	68.55
Ash	9.58	6.05
	100.00	100.00

and the two benches of the M'Gregor seam at the Acadia Mine gave an analyst not named:—

	No. 1.	No. 2.
Volatile matter	22.50	23.30
Fixed carbon	65.70	70.00
Ash	11.80	6.70
	100.00	100.00

(Mineralogy of N. S. pp. 22–27.)

The series of 31 assays made by Dr. Dawson of the coal from the main seam at the Albion Mines, Pictou Co., taken throughout at distances of one foot thickness, shows a variation per cent within these limits:—

Volatile Matter by rapid coking. A	Volatile Matter by slow coking B	Fixed Carbon C	Ash D
From 22.2 to 32.6	19.9 to 26.1	50.4 to 68.5	8.7 to 28.1

The series of 15 assays of coal taken at distances of one foot throughout the deep seam at the same mine, by Dr. Dawson, shewed variations per cent. under the same heads as above:—

A	B	C	D
From 23 to 29	19.9 to 25.2	48 to 71.5	53 to 21.6

The set of analyses by Mr. Poole of coal from distances of one foot throughout the Wayland Seam, Caledonia Coal Mine, Glace Bay, C. B., eight in number, gave variations per cent:—

Volatile Matter.	Fixed Carbon.	Ash.
From 27 to 37.5	51.7 to 61.1	5 to 17.8

The details of the instructive analyses of which the foregoing is the summary, are given in *Acadian Geology*, Second Edition, pp. 334, 336, and 419.

Jukes goes on to say: "Some idea of the immense varieties of coal may be gained from an inspection of the report of the Admiralty Coal Investigation, as well as from the varying qualities of those which we are in the habit of using in our houses. As many as seventy denominations of coal are said, by Ronald and Richardson in '*Chemical Technology*,' to be imported into London alone."

"All these minute varieties are commonly included under four principal heads:—1. *Caking Coal*; 2. *Splint* or *Hard Coal*; 3. *Cherry* or *Soft Coal*; and 4. *Cannel* or *Parrot Coal*."—(*Loc. cit.* p. 133.)

Dana adopts the arrangement of the principal kinds of bituminous coal into: "1, *Caking Coal*; 2, *Non-Caking Coal* including *cherry* or *soft coal* which ignites well and burns rapidly, and *splint* or *hard coal* which ignites less readily and burns less rapidly, owing to the smaller amount of volatile matters (coals which do not cake on burning are called 'free burning' coals, while the caking are called 'binding' coals); and 3, *Cannel Coal* (*Parrot Coal*) a variety of bituminous coal, and often caking, but differing from the preceding in texture, and to some extent in composition, as shewn by its products on distillation."—(Mineralogy, Fifth Edition, p. 755.)

Miller makes a class of *steam coal* between bituminous coals and anthracites: "it burns freely and with flame, giving out a steady heat, but it does not yield sufficient volatile matter to be advantageously employed in the preparation of coal gas. It is well fitted for use in the steam navy, since it does not crumble readily, and it emits but little smoke. Its coke scarcely cakes, and has little coherence or lustre. Much Welsh coal is of this description."—(Elements of Chemistry III. 99, First Edition.).

Consideration of the conditions under which coal beds could have been formed, and late researches into the minute structure of the dissimilar layers of the beds, have afforded insight into the causes of the differences just mentioned and indicated by the terms employed to distinguish the varieties of coal. The second edition of "Acadian Geology," may be consulted with advantage on these points, on which a brief remark or two here may not be uninteresting. Dr. Dawson observes that coal is proved beyond question to have accumulated by growth *in situ*; while the character of the sediments between the beds proves equally the abundant transport of mud and sand by water; that the true coal consists principally of the flattened bark of sigillarioid and other trees, mixed with leaves, and fragments of decayed wood, all these materials having manifestly alike grown and accumulated where we find them; that the microscopical structure and chemical composition of the beds of cannel-coal and earth, bitumen, and of the more brightly bituminous and carbonaceous shales, show them to have been of the nature of the fine vegetable mud which accumulates in the ponds and shallow lakes of modern swamps; when such fine vegetable sediment is mixed with marl it becomes similar to the bituminous limestone and calcareo—bituminous shales of the coal measures, (p. 138). Further on we find:—In ordinary bituminous coal we recognize by the unassisted eye laminæ of a compact and more or less lustrous appearance, separated by uneven films and layers of fibrous anthracite or mineral charcoal, and these two kinds of coal demand a separate consideration. They are shown to result from certain chemical changes, and the conclusion arrived at is that the mineral charcoal is formed by subaërial decay, and the compact coal by subaqueous putrefaction, more or less modified by heat and exposure to air. It is added that in coals, like cannel-coals, which have been formed wholly under subaqueous conditions, the mineral charcoal is deficient. The compact coal, constituting a far larger proportion of the mass than the "mineral charcoal," consists either of lustrous conchoidal *cherry* or *pitch coal*, of less lustrous *slate coal*, with flat fracture, or of coarse coal, containing much earthy matter. All of these are arranged in thin interrupted laminæ. They consist of vegetable matter which has not been altered by subaërial decay, but which has undergone the bituminous putrefaction, and has thereby been resolved into a nearly homogeneous mass, which still, however, retains traces of structure and of the forms of the individual plants composing it. The mineral charcoal affords the greater part of the material shewing distinct vegetable structures, the kinds of tissue in which are minutely described. (pp. 462, 466).

With reference to cannel coal, it was allowed by the microscopists on both sides of the question to be alluded to presently as to what substances are entitled to the name of "coal," that it affords clear evidence of its origin by exhibiting distinct vegetable tissues, though not so readily as common coal. Dr. Redfern, for example, one of those who would have made the term coal include what the other side considered a different mineral, said he found vegetable structure in six cannel coals. On the other side, Dr. Adams said he believed he had examined 40 or 50 different specimens of cannel coals, (of so many varieties?), and that, though the organic structure could be traced, it required more skill to find it than in ordinary coal, on account, as he believed, of the structure being much more compact in the cannel coal, and an exceedingly thin section being required, which it was found difficult to procure from the nature of the material. * Dr. Rowney, in his paper shewing the chemical composition of mineral charcoal to resemble that of anthracite, (Ed. Phil. Jnl. July 1855), indeed, says that this fibrous substance, described above as full of tissue remains, is found in cannel coal, but not in very great amount.

With regard to the second point above mentioned—the position of oil coals—it will be in the recollection of many members of the Institute that an important case was tried in Halifax some few years ago in which the matter in dispute was whether the black substance found at Hillsborough, in New Brunswick, was a coal. It may also be remembered that not long afterwards a similar issue

* Report of Trial, Gillespie *vs.* Russel.—Edinburgh, 1853.

was raised respecting the black-brown substance found at Torbane Hill, Linlithgowshire, Scotland, and that several trials were held, one after the other, to decide the question. I was one of numerous witnesses engaged to give evidence in the first of these trials held in Edinburgh, just referred to in a note, in which there were 78 witnesses examined, 33 for the plaintiff and 45 for the defendant, while a number were engaged, but not called on for want of time,—a curious *legal* deficiency. The witnesses consisted of geologists, mineralogists, chemists, microscopists and practical men connected with mining. Though the view I took, in common with a large proportion of the scientific witnesses, that the substance was not a coal, was not in accordance with the verdict, which indeed resulted from "the court virtually setting aside the discordant scientific evidence, and deciding on the legal merits of the commercial bargain," it was pleasant to learn in a short time that the mineral was admitted into Germany, where there is certainly some scientific knowledge, under a tariff different from that applied to coal, and also, years after, that the agreement finally come to by the litigants was to call the substance "the mineral in dispute:" it is now very frequently called Torbanite. It will be useful, as bearing on somewhat similar minerals found here, to mention the facts brought out as to the minute structure of Torbanite. While microscopists on both sides found tissue present, it was urged by the "non-coal" witnesses that these were due to accidental fragments of coals. Professor Quekett, for example, in his paper "On the Minute Structure of a Peculiar Combustible Mineral from Torbane Hill," (Qu. Jnl. Microscopical Science, 1854), states "that the Torbane-hill mineral is not, microscopically speaking, a Coal; that it is not like any of the combustible substances used in this country as a Coal, and that, although possessing some of the properties of Coal, it is, notwithstanding, a mineral *sui generis*, having a basis of clay which is strongly impregnated with a peculiar combustible principle, and that when plants are found in it, they are accidental, and have no more been concerned in the formation of the mineral than has a fossil bone in that of the rock in which it may be imbedded." The mode in which such deposits may have originated is given above from "Acadian Geology," p. 138, and is further dwelt upon by Dr. Dawson in connection with the Albertite of New Brunswick, which he now considers to be an altered asphalt, deposited in a vein or fissure, "and it only remains to consider whence the supplies of liquid bitumen could have been obtained. I have no hesitation in assigning them to the highly bituminous lower carboniferous shales. These beds are manifestly of the same character with the so-called 'oil-coals,' of Nova Scotia, and the earthy bitumens of Scotland. They must have been beds of mud charged with a great quantity of finely comminuted vegetable matter, of the nature of peaty muck, which has become perfectly bituminized, and which probably in an earlier stage of its formation was more prone to edge into fissures as a liquid petroleum than at present." (*Loc. cit.* p. 240). The best known "oil-coal" of the province is the "stellar-coal" of New Glasgow, which I have, for the sake of distinction, called Stellarite on giving a full comparison of its ultimate and proximate composition with those of Albertite and Torbanite in my "Report on the Mineralogy of N. S.," (p. 25). Bitumen, in some respects analogous to Albertite, as shewn in a paper of mine ("Contributions to Mineralogy of N. S.," II., L. E. D. Phil. Mag. 1867), was found by Mr. Barnes in limestone at Grand Anse, C. B., in globular and rounded masses in the rock, and in and among crystals of calc-spar on the rock. Liquid bitumen or petroleum is now circumstantially reported to have been found flowing from a rock at Lake Ainslie, C. B., and to have been discovered at Salmon River, Guysborough Co., N. S., and recently at Hantsport, Hants County.

Results of the official Enquiries made in U. S. and England on coals, etc.—The following tables are constructed to show at a glance some of the most important results brought out in these two valuable enquiries, A summary only of the very numerous details can be given in each case, and this is done so as to allow of comparison as far as possible. Though the averages are not from the same number of trials on the same number of fuels, they are interesting not only as regards the use of fuel for steam purposes, but in various other respects. The evaporative power is shewn by the number of pounds of water actually converted into steam at 212."

Summary of Results of Experiments on Fuels, by Prof. W. R. Johnson, at the U. S. Navy Yard, Washington, 1842–1843:

NAME AND LOCALITY OF FUEL.	Averages obtained from			Practical Evaporative Power.	Weight in lbs. of one c. ft. of fuel as used.	Storage space in c. ft. of one ton.	Proximate Analysis: Percentages. Moisture.	Volatile combustible matter	Fixed Carbon.	Ash.	Sulphur.
	Expts.		Fuels.	A.	B.	C.	D.	E.	F.	G.	H.
Coal, Anthract., Pennsyl.	9	on	6	9.59	53.35	42.14	1.19	3.98	88.54	6.51	0.052
" Bituminous, "	9	"	7	9.32	52.55	42.67	1.17	16.02	72.47	10.13	0.722
" " Maryland.	5	"	5	9.98	53.11	42.17	1.25	14.20	75.05	9.49	....
" " Virginia..	10	"	8	8.48	48.76	45.72	1.62	29.50	58.30	10.58	1.090
" " Foreign ..	6	"	5	8.06	50.00	44.87	2.06	35.11	57.66	8.45	0.433
" Do. W. of Alleg. Mt	2	"	2	7.77	47.23	47.43	2.00	35.30	56.68	6.02	0.160
" mixed, 4 An. to 1 Bit.	2	"	2	9.02	52.90	41.18	....	.....	.....	.....	.....
Coke, art. of Vir. & Md. Cl.	2	"	2	8.82	32.14	69.72	....	.....	.....	14.94	.....
" Natural, Virginia..	1	"	1	8.47	46.64	48.03	1.11	11.97	75.08	11.82	0.466
Wood, Dry Pine........	1	"	1	4.69	21.01	106.62	3 67	.....	.....	0.31	.....

Among the foreign coals in the foregoing table are two Nova Scotian coals, from which the following are the results under the heads specified above:

	Expts.		Fuels.	A.	B.	C.	D.	E.	F.	G.	H.
Coal, Bit., Pictou, N. S..	1	on	1	8.41	53.55	41.83	2.56	27.06	56.98	13.38	0.769
" " (Cunard's)...	"	"	"	8.49	49.25	45.48	0.78	25.79	60.73	12.51	.....
" " Sydney, C. B.	"	"	"	7.99	47.44	47.21	3.12	23.81	67.57	5.49	.....

Summary of Results obtained in the British Coal Enquiry, at Putney, 1856–52, under heads specified above:

		A.	B.	C.
Coals, Bitumin. *Wales..	37 samples.	9.05	53.10	42.71
" " Newcastle..	17 " .	8.37	69.18	45.30
" " Lancashire.	28 " .	7.94	49.70	45.15
" " Scotland...	8 " .	7.70	50.00	44.80
" " Derbyshire.	8 " .	7.58	47.20	47.45

As all the details necessary for arriving at the average chemical composition of the coals examined in the British Enquiry are not at hand, I give that of some representative coals as found by my own analyses, together with practical and theoretical evaporative power in each case, in the following

* And a very few Anthracites.

Table shewing the Value as Steam-Fuel and the Proximate Composition of some Representative British Bituminous Coals :—

LOCALITY OF COAL.	QUALITY.	Evaporative Power.		Proximate Analysis: Percentages.					Analyst.
		Practical.	Theoretical.	Moisture.	Vol. Com. Matter.	Fixed Carbon.	Ash.	Sulphur	
Ebbw Vale, Wales.	Caking ...	10.21	10.44	1.34	21.16	76.00	1.50	1.02	H. How
Duffryn, "	Not-Caking	10 15	11.13	1.13	14.17	81 04	3.26	1.77	"
Mynydd Newydd. "	Caking ...	9.52	9.83	0.61	24.59	71.56	3.24	1.21	"
Sydney, England...	Not-Caking	8.52	6.56	2.78	39.42	47.80	10.00	2.27	"
Broomhill, " ..	Not-Caking	7.30	7.71	9.31	31.49	56.13	3.07	2.85	"
Grangemouth, Scotd	Splint	7.40	7.29	6.42	36.98	53.08	3.52	1.42	"
Fordel, "	Splint	7 56	6.58	8.40	39.57	48.03	4.00	1.46	"

It will be observed on comparing this table with the foregoing that though some of these British coals are practically of the same evaporative value as some of the American as shewn by the average of Professor Johnson's results, while those at the head of the list are superior to any American fuel examined, the chemical composition is decidedly different; this is especially seen on comparing the Pennsylvania anthracite with the Welsh bituminous coal; the evaporative value being nearly the same, the latter contains very much more volatile combustible matter. The theoretical evaporative power is given above in order to show that, while it is not identical with the practical, which, as is obvious from a comparison of the results brought forward, depends upon various conditions, it affords a useful index to the steam-value of a coal in the absence of a practical scientific trial; and it appears that when the amount of volatile combustible matter is moderately large the approximation of these two numbers is sometimes rather close. At the same time it is evident that there are differences not accounted for by chemical analyses, and it follows that the only way of arriving at the absolute truth with regard to the heating power of a coal is by a trial under well considered circumstances, as in the enquiries so frequently mentioned.

Average Quality of Nova Scotian Coal, etc.—Average results having been given with regard to groups of British and American coals, I propose, in proceeding to compare those of this province to take them in groups from the different coal-fields and show average results; it is to be regretted that there are not sufficient details to make those of the groups of equal value, or to allow of complete comparison with the foreign coals. Here follows a

Table shewing the Theoretical Value as Steam Fuel and the Average Proximate Composition of some Groups of Nova Scotian Coals:

LOCALITY OF COALS.	AVERAGES OBTAINED FROM	Theoretical Evaporative Power.	Percentages. Volatile Matters.	Fixed Carbon.	Ash.
Pictou Co., N. S.	12 Expts. on 5 Coals.	8.78	27.37	63.97	8.66
Cumberland Co., N. S.	4 " " 3 "	7.97	32.99	58.04	8.97
Cape Breton Co., C. B.	13 " " 4 "	8.58	32.14	62.50	5.36
Inverness Co., "	2 " " 2 "	8.16	31.51	59.41	9.08
Richmond Co., "	1 " " 1 "	7.93	30.25	56.40	13.35

It appears on comparing this and the foregoing official tables, considering what has been said with reference to the theoretical evaporative value being generally rather close to the practical when the volatile matters are moderately high, that the coals of this province should stand in a good position as steam producers, and this is quite consistent with their character in the market, for it is well known that several of these are highly esteemed on this account. (See "Acadian Geology," and "Mineralogy of Nova Scotia.")

As Gas-Producers, several of the provincial coals are in considerable repute, as is shown by the fact that they have been for some time mentioned in the price lists of the U. S. as gas coals.

The average yield of coals from Pictou county, as indicated by nine trials on fair and good coals, is 8093 cubic feet gas to the ton of 2240 lbs., some samples giving 9500 and 10000 feet. The illuminating power of the gas is sometimes up to 16 candles. The average yield of English Newcastle coal is given as 8500 cubic feet, and the Parliamentary illuminating standard, in London, where a good deal of this coal is used, is 12 candle, but the gas is actually 14 candle at times. In Boston, U. S., 15 candle gas is burnt from Pictou coal.

The majority of the coals quoted in the American lists are from Cape Breton; the yield of gas is reported as large in some of these, numerical results have been obtained for two cases only, in each of which the amount per ton, of 2240 lbs., was 8500 cubic feet.

Oil-coals.—The best known of the mineral substances so called, found here, occurs, as already mentioned, near New Glasgow, Pictou Co. The name I have proposed for it, "Stellarite," like the local term "Stellar Coal," alludes to the fact that flaming particles scintillate from the lighted mineral. The substance, or one very similar, is found on both sides of the East River, at four localities, at least, which mark an extensive area of distribution. The following and other particulars respecting it will be found in "Mineralogy of N. S." (p. 26). Stellarite compares favourably with other oil-minerals :—

	Crude oil per ton.
Union Oil Coal of West Virginia affords	32 gallons
Elk River " " " "	54 "
Kanawha " " " "	88 "
Lesmahagow Cannel Coal, Scotland	40 "
Albertite, New Brunswick	92 to 100 "
Torbanite, Scotland	116 " 125 "
Stellarite, Nova Scotia, No. 2	50 " 74 "
" " " No. 1	123 " 126 "
" " from picked samples in Boston	119 "

Some of these results are the amounts yielded by careful experiments on the small scale: when oil was made at the Fraser mine in 1852, the practical yield was about 60 gallons crude, and from 30 to 35 gallons fine clarified, oil to the ton.

Oil coal has been described by Mr. Campbell as occurring near Antigonish, but no trial, I believe, has been made of its quality.

Oil Shales.—Little is known of the adaptability of the numerous shales of the coal measures to the distillation of oil. The greatest yield obtained in the few experiments made by myself has been 35 gallons crude oil to the ton, an amount found remunerative, I believe, in Scotland.

Cannel Coal.—Several seams of cannel coal are mentioned by Prof. Lesley as occurring between Burnt Head and Little Glace Bay, Cape Breton. (Acadian Geology, Second Ed., p. 414). These are generally very thin, the thickest is 18 inches. An examination of a specimen of cannel coal given me by Dr. Paddock "from an eighteen inch seam at Little Glace Bay, C. B." afforded me these results :—

Moisture	0.83
Volatile Combustible matter	33.07
Fixed carbon	44.42
Ash	24.68
	100.00

The amount of ash, though considerable, is smaller than that in the well known Scotch cannel from Capeldrae, which gives 25.40 per cent. The volatile combustible matter is evidently high enough in proportion to the fixed carbon to mark the character of the mineral.

Art. XII. Nova Scotian Coleoptera. Part I. By J. Matthew Jones, F. L. S.

To form a complete list of any particular order of insects inhabiting a country of some extent, requires the united labour of divers entomologists, and that continuous for several years; but in a new, and I may almost say, untouched field * like the province of Nova Scotia presents, the isolated entomologist can look forward to nothing better than a meagre addition from time to time to the small collection he is able to form. It is to be hoped, however, that our Institute is gradually maturing the work it was designed to effect, viz.: the engendering in the minds of our people a love of nature; and that ere a few years have elapsed, some of its members will take up the study of entomology, and render service in the cause of promoting a knowledge of that interesting branch of Natural History.

The services of an entomologist, who can set before the inhabitants of the land in which he lives the various injuries done by certain species, and the direct benefits conferred by others, are of great value; and as there is no country in the world in which the people do not suffer in a greater or lesser degree from damage to growing crops, produce in bulk, clothing materials, and in fact almost every thing capable of being injured by the myriad forms of insect life which everywhere exist, a knowledge of insects, their habits, haunts, and economy, is very desirable, as it may be the means of saving much valuable property, even to the extent of many thousand pounds per annum. Indeed, a writer in a recent American magazine asserts that "*taking one year with another the United States suffer from the depredations of noxious insects to the annual amount of* $300,000,000."

Under these circumstances, therefore, it is a matter of some importance to ascertain whether injurious insects are to be found abundantly or otherwise in the country we live in; and hence, the necessity of publishing lists of native insects as often as the dili-

* I am not aware of any collection ever having been made in this country and scientifically described, save that of Lieut. Redman, who some 40 years ago collected for the British Museum, and in the cabinet of which institution it may now be seen still in an excellent state of preservation. It is chiefly composed of *Diptera*.

gence of collectors will allow of such publications. If for this and no other reason this present incomplete list of the Coleoptera of the province is offered to the Institute I trust it will be received as a small contribution to our monthly papers, and that (D. V.) I may be allowed to continue the subject at some future time.

I must not omit to express the obligation I feel myself under to the Rev. C. J. S. Bethune, of Credit, Ontario (Secretary to the Entomological Society of Canada), who very kindly identified nearly the whole of the species comprised in this list; and to Melsheimer's Catalogue of United States Coleoptera, and Mr. Ritchie's excellent Catalogue of Montreal Coleoptera, published in the 'Canadian Naturalist,' I owe my synonyma.

Fam. CICINDELIDÆ.

Gen. CICINDELA.

1. *Cicindela vulgaris*, Say.
C. obliquata, Dej.
C. Tranquebarica, Herbst.

Common in the interior of the country, particularly on the highroads about Truro. It is not so common, however, in the neighborhood of the Atlantic coast, where *C.* 12 *guttata* is more abundant.

2. *Cicindela albilabris*, Kirby.
C. longilabris, Say.

This species, which seems to be rare in the Northern United States and Canada West, is of frequent occurrence in the neighborhood of Halifax: indeed, I may almost say more abundant than *C. vulgaris*. There can be no mistake as to the insect, for the lengthened light coloured labrum is peculiar to this species. From the fact of its being, as far as I have observed, only common over the more barren portions of this province, coupled with the knowledge of its also frequenting the barren shores of the Arctic Sea in lat. 70° N., where it was taken by Sir John Richardson, as also Fort Simpson, on the Mackenzie River; it would appear that the rocky and uncultivated districts of North America, in the vicinity of the sea, sparsely clothed with vegetation, are more suited to its habits. Of eight specimens now before me, some have the white dots and angular medial marking on the elytra much more distinct than others. It makes its appearance in spring earlier than any of our Cicindelas, as I have taken it at the end of April.

3. *Cicindela* 12, *guttata*, Dej.

C. Proteus, Kirby.

This may be considered the most common species in the neighborhood of Halifax, where, in open spots, and more especially "Halifax Common," it may be taken in hundreds. On that portion of this open plain called "Camp Hill," those parts which are destitute of grass, are perfectly riddled with the larval holes of this insect. In damp, foggy, or rainy weather, I have observed it lying partially torpid beneath surface stones.

4. *Cicindela* ———? Of this rare species I have only three specimens, which I have not yet identified.

5. *Cicindela* ———? Another species, rare, and undetermined.

Fam. CARABIDÆ.

Gen. Elaphrus.

Elaphrus ruscarius, Say.

E. Americanus, Dej.

The only specimen I have seen, is one in the possession of Mr. Arthur Silver, by whom it was taken at River Bank, Preston.

Gen. Calosoma.

Calosoma calidum, Fabr.

C. lepidum, Lec.

This carab cannot be considered as abundant in the neighborhood of Halifax, although fine specimens may be obtained in the heat of summer on "the Common" hunting amid the scanty herbage for prey. I have never observed it in the forest. It appears to be partial to the colder regions of North America, and specimens have been taken as far north as the Mackenzie and Slave Rivers, between lat. 58° and 65° N.

Gen. Cychrus.

Cychrus Lecontei, Dej. Rare. I have only taken one specimen.

Gen. PTEROSTICHUS.

1. *Pterostichus lucublandus*, Lec.
Feronia lucublandus, Say.
Poecilus lucublandus, Kirby.

Common under stones; Halifax common. A pungent odour emanates from it when handled.

2. *P. chalcites*, Lec.
Feronia chalcites, Say.
Poecilus Sayii, Brulle.
Poecilus chalcites, Kirby.
Poecilus micans, Chand.

Very common in gardens during the hottest days of summer.

3. *Pterostichus* ——? A large species; rare.
4. *Pterostichus* ——? Rare.

Gen. PLATYNUS.

1. *Platynus extensicollis*, Lec.
Feronia extensicollis, Say.
Anchomenus extensicollis, Ibid.
A. Lecontei, Dej.
—var. *proximus*, Harris, New. Eng. Farmer.

Common under stones on the shores of Halifax harbour, near tidal marks. This insect must be able to lead a partially amphibious life, for I find the places it frequents perfectly wet with the salt water.

2. *Platynus cupripennis*, Lec.
Feronia cupripennis, Say.
Agonum cupripenné, Dej.

Very common in gardens, where it may be found all day and also in the darkness of night, busily searching for food.

3. *Platynus* ——? This, and two or three other species in my collection, yet undetermined.

Gen. AMARA.

Amara obesa, Say.
Percosia obesa, Lec.

Of this carab I have only obtained one specimen, and consider it rare about Halifax.

Fam. DYTISCIDÆ.

Gen. Dytiscus.

Dytiscus marginalis, Linn.

Not uncommon in the lakes with which this province abounds. It answers in every particular the characteristics of the European species.

Gen. Hydaticus.

1. *Hydaticus* ——? Species undetermined. It appears early, as I have observed it moving about in a lake on the 4th of April.

2. *Hydaticus* ——? Species undetermined.

Fam. GYRINIDÆ.

Gen. Gyrinus.

Gyrinus ———? Very common on all our lakes and streams, appearing about the last week of April.

Fam. SILPHIDÆ.

Gen. Necrophorus.

1. *Necrophorus Americanus*, Oliv.
N. grandis, Fabr.
N. virginicus, Frölich Natf.
Common in putrid carcases of animals.

2. *Necrophorus orbicollis*, Say.
N. Hallü, Kirby.
N. 4 *maculatus*, Dej.
var. *tibialis*, Lec.
Not quite so common as the preceding species, in similar situations.

3. *Necrophorus velutinus*, Fabr.
N. tomentosus, Web.
Not common.

4. *Necrophorus* ———? A fine species somewhat larger than *N. orbicollis;* rare.

5. *Necrophorus* ———? A small species ; rare.

Gen. SILPHA.

Silpha Surinamensis, Fabr.
Necrodes Surinamensis Oliv, et Herbst.

Common in putrid flesh, with the *Necrophori*. Some specimens are of a light chesnut colour and smaller than the darker ones.

2. *Silpha Americana*, Linn.
Oiceoptoma affine, Kirby.
Necrophila peltata, Lec.
Scarabeus peltatus, Cates.

By far the most common of our *Silphæ*.

3. *Silpha marginalis*, Fab.
Oiceoptoma marginata, Kirby.
O. noveboracensis, Forst.

Common.

4. *Silpha lapponica*, Linn.
Thanatophilus caudatus, Say.
T. tuberculata, Germ.
T. Californica, Mann.
T, granigera, Chevr.

Rare about Halifax. This species appears to have a wide range in North America, having been taken at Lake Superior, and as far north as the Mackenzie and Slave rivers.

Fam. STAPHYLINIDÆ.

Gen. CREOPHILUS.

Creophilus villosus, Grav.
Staphylinus villosus, Kirby.
S. fasciatus, Lap.

Not uncommon in decayed animal, and more particularly, vegetable matter, cattle droppings, &c. This species is also known in the Hudson's Bay Territory.

Gen. LEISTOTROPHUS.

Leistotrophus cingulatus, Perty.
Staphylinus cingulatus, Grv.
S. speciosus, Mann.
S. chrysurus, Kirby.

Not common.

NOTE.—Two or three other Staphylines undetermined.

Fam. HISTERIDÆ.

Gen. Hister.

1. *Hister* ———? Undetermined; rare.
2. *Hister* ———? Another species; rare.

Fam. DERMESTIDÆ.

Gen. Dermestes.

Dermestes lardarius, Linn.

Very common. A perfect nuisance to the collector, whose zoological specimens are never safe from its ravages.

Fam. BYRRHIDÆ.

Gen. Byrrhus.

Byrrhus ———? Not determined.
Byrrhus ———? Not determined.

Fam. SCARABÆIDÆ.

Gen. Aphodius.

1. *Aphodius fossor*, Fabr.
Scarabæus fossor, Linn.

Common in cattle droppings.

2. *Aphodius fimetarius*, Hald.
A. nodifrons, Rand.
Scarabæus fimetarius, Linn.

Very common. It is one of the first insects to appear in spring as soon as the frost disappears, frequenting the highroads, where it alights upon the cattle droppings. It is identical with the British species, being of similar size to those I have taken in North Wales; but smaller than those taken in Dorsetshire.

3. *Aphodius scybalárius*, Fabr.

This European form is not uncommon about Halifax in company with the preceding species. There can be no doubt as to its identity, for I have English specimens of my own collecting for comparison. I do not find it in any of the American catalogues.

Gen. SERICA.

Serica vespertina, Lec.
Melolontha vespertina, Schon.
Omaloplia vespertina, Har.
Camptorhina atricapilla, Kirby.

Very common, It hybernates in the ground, and many specimens may be procured where ploughing is going on late in the autumn.

Gen. DIPLOTAXIS.

Diplotaxis liberta, Germ.
D. moesta, Say.
D. tristis, Kirby.
Not common.

Gen. LACHNOSTERNA.

Lachnosterna fusca, Lec.
Melolontha fusca, Frohl.
M. quercina, Kroch.
M. fervens, Gyll.

Gen. OSMODERMA.

Osmoderma scabra, Dej.
Trichius scabra, Beauv.
Gymnodus foveata, Kirby.

Rare; taken by Mr. Arthur Silver, at River Bank, Preston.

Gen. TRICHIUS.

Trichius piger, Fabr.
T. rotundicollis, Kirby.
T. Drummondii, Gor et Perch.
Common; on the wild rose and other flowering shrubs.

Fam. BUPRESTIDÆ.

Gen. DICERCA.

Dicerca divaricata, Lec.
D. dubia, Melsh.
Buprestis divaricata, Say.
Stenuris divaricata, Kirby.
Not uncommon.

Gen. ANCYLOCHEIRA.

1. *Ancylocheira maculiventris*, Lec.
Buprestis maculiventris, Say.
B. sexnotata, Lap.
Anoplis rusticorum, Kirby.

Not uncommon.

2. *Ancylocheira fasciata*, Dej.
A. sexmaculata, *Herbst*.

Rare; taken by Mr. Arthur Silver, at River Bank, Preston.

3. *Ancylocheira* ——? Rare; a very beautiful species about the size of *A. maculiventris*. Elytra grooved longitudinally between five ridges, including suturals. Outer margin deeply indented, cupreous. Suture broadly margined with cupreous, expanding anteriorly. The two central grooves metallic green. Thorax punctured, cupreous, metallic green.

Gen. CHALCOPHORA.

Chalcophora virginica, Drury.
C. virginiensis, Herbst.
Buprestis mariana, Linn.

Common.

Fam. ELATERIDÆ.

Gen. ELATER.

1. *Elater nigricollis*, Herbst.

Not uncommon.

2. *Elater* ————? A species having two buff patches on outer margin of elytra. Taken under dead spruce bark in Point Pleasant Woods.

Gen. MELANOTUS.

Melanotus scrobicollis, Lec.

Not common.

Gen. CORYMBITES.

Corymbites hieroglyphicus, Say.
Selatosomus hieroglyphicus, Steph.

Not uncommon; taken by Mr. Arthur Silver, at River Bank, Preston.

2. *Corymbites aeripennis*, Lec.
Elater aeripennis, Kirby.
E. appropinquans, Rand.

3. *Corymbites* ———? Species undetermined.

Note.—Four or five other species of small size, undetermined.

Gen. Asaphes.

Asaphes memnonius, Herbst.

Not uncommon.

Fam. LAMPYRIDÆ.

Gen. Photinus.

Photinus corruscus, Lac.
Lampyris corrusca, Linn.
Ellychnia latipennis, Motsch.
E. corrusca. White. (Brit. Mus. Cat.)
Pyractomena fenestralis, Melsh.

Very common. This species is widely distributed over the northern parts of America, and is found as far west as Lake Winnipeg.

Gen. Photuris.

1. *Photuris Pennsylvanica*, Lec.
Lampyris versicolor, Fabr.
L. Pennsylvanica, De Geer.

Our common fire fly. The light emitted is sufficient to enable the collector to read the lines of his note book when the insect is held close over it. It generally appears about the end of June, but I have seen it much earlier. It seems to delight in dark nights with a close humid atmosphere.

2. *Photuris* ———? A small species, undetermined.

Fam. TENEBRIONIDÆ.

Gen. Upis.

Upis ceramboides, Fabr.
U. reticulata, Say.
Tenebrio ceramboides, Linn.

Not common. This species extends as far north as lat. 63°, near the southern confine of the Arctic Circle, and as far west as the Mackenzie River.

Gen. IPHTHINUS.

Iphthinus serratus, Mann.
Nyctobates serratus, Beit.
Not common.

Gen. TENEBRIO.

Tenebrio obscurus, Fabr.
Not common.

Tenebrio molitor, Linn.
Not common.

Fam. MELOIDÆ.

Gen. MELOE.

Meloe angusticollis, Say.

Halifax Common; abundant about the first week in June, when the sexes pair.

Fam. OEDEMERIDÆ.

Gen. NACERDES.

Nacerdes melanura, Schmdt.
N. notata, Fabr.
N. analis, Oliv.
N. apicialis, Say.
Cantharis melanura, Linn.
Rare.

Gen. CANTHARIS.

1. *Cantharis* ———? Rare; Taken by Mr. Arthur Silver, at River Bank, Preston.
2. *Cantharis* ———? Rare; Taken in the same locality.
3. *Cantharis* ———? Rare; Taken in the same locality.

Fam. CURCULIONIDÆ.

Gen. PISSODES.

Pissodes nemorensis, Germ.

Rare. Taken by Mr. Silver, at River Bank, Preston.

Gen. HYLOBIUS.

1. *Hylobius pales*, Herbst.
H. macellus, Germ.

Very common, frequenting wooden dwellings and out-houses. This beetle in the larva state is probably more destructive to our pine trees than any other in the province. Its ravages in certain parts of the United States are very great, and the observant naturalist Wilson many years ago, endeavoured to befriend the family of woodpeckers, by proving the vast amount of good they did in consuming numberless larvæ of this insect.

1. *Hylobius* ———? Species undetermined.
2. *Hylobius* ———? Species undetermined.

Fam. CERAMBYCIDÆ.

Gen. CRIOCEPHALUS.

1. *Criocephalus agrestis*, Kirby.

Common.

2. *Criocephalus* ———? A smaller species undetermined.

Not common.

Gen. CALLIDIUM.

Callidium violaceum, Fabr.
Cerambyx violaceus, Linn.

Rare. This is another insect destructive to the pine trees, and is common to Europe and America.

Gen. CLYTUS.

1. *Clytus caprœa*, Say.
C. elevatus, Lap.
C. gibbicollis, Ibid.

Not common.

2. *Clytus* ———? Another species undetermined, rare; taken by my eldest boy W. Salton Jones.

Gen. MONOHAMMUS.

Monohammus titillator, Fabr.

Very common. Numbers of these insects may be obtained in the forest about August, where the Weymouth Pine *(Pinus strobus)* has been cut down. I have never, however, met with them on any species of *Abies,* although some lay near the pines. From this circumstance I am inclined to believe that the larva lives in our common pine.

2. *Monohammus scutellatus,* Say.
M. resutor, Kirby.

Very common. Also taken on the newly fallen Weymouth Pine. This species has an extensive range in British America, being found as far north as lat 63°, and as far west as the Mackenzie River.

Monohammus ———? A very handsome species, rather larger than *M. titillator,* with elytra and thorax prettily dappled with patches of white and yellow hairs, and the whole shining with a gloss as if varnished. I have only one specimen in my collection taken at Mount Uniacke, and kindly given me by the hospitable owner of that charming retreat, the Rev. Fitzgerald Uniacke.

Gen. Saperda.

Saperda candida, Fabr.
S. bivittata, Say.

Rare. In the larval state this is the well known apple tree borer of the northern United States, which commits such sad ravages in the orchards. The only specimen I possess was taken at the foot of an apple tree at Ashbourne. In the apple growing districts of Annapolis and Cornwallis it may be more common than it is near Halifax, where these fruit trees are not much cultivated.

Gen. Rhagium.

Rhagium lineatum, Kirby.
Stenocorus lineatus, Oliv.
Common.

Gen. Typocerus.

Typocerus fugax, Fabr.
Strangalia fugax, Sch.
Leptura tenuior, Kirby.

Extremely common; frequents the yellow blossoms of the Golden Rod (*Solidago*) and other flowers.

Gen. Leptura.

1. *Leptura elegans*, Lec.
Strangalia elegans, Dej.
Rare.

2. *Leptura vittata*, Oliv.
L. abbreviata, Germ.
L. semivittata, Kirby.
Rare.

3. *Leptura auripilis*, Lec.
Not uncommon.

4. *Leptura Canadensis*, Oliv.
L. tenuicornis, Hald.
Common.

5. *Leptura erythroptera*, Kirby.
L. cinnamoptera, Hald.
Rare.

6. *Leptura chryscoma*, Kirby.
Rare.

7. *Leptura* ———? Species undetermined; rare.
8. *Leptura* ———? Small species undetermined; rare

Fam. CHRYSOMELIDÆ.

Gen. Chrysomela.

1. *Chrysomela Philadelphica*, Linn.
Calligrapha Philadelphica, Chev.
Rare.

2. *Chrysomela polygoni*, Linn.

This European form is very common in the neighbourhood of Halifax on grass stalks in waste ground.

3. *Chrysomela elegans*, Oliv.

Rare. Taken by Mr. A. Silver at River Bank, Preston. The vertical yellow stripes on the elytra and the marginal band of the same colour around the thorax, are sometimes deep orange.

4. *Chrysomela* ———? A species of the size of *C. Philadelphica*, undetermined.

5. *Chrysomela* ———? Undetermined; rare.

Fam. COCCINELLIDÆ.

Gen. COCCINELLA.

1. *Coccinella trifasciata,* Linn.
C. perplexa, Muls.
Common.

2. *Coccinella bipunctata,* Linn.
Adalia bioculata, Say.
Extremely abundant.

Gen. HIPPODAMIA.

Hippodamia 13 *punctata,* Linn.
H. tibialis, Say.

Rare. Taken by Mr. A. Silver at River Bank, Preston. This species has a wide range over British America, being found at Lake Superior, and as far to the north-west as Great Bear Lake in lat 69° N. long 120° W.

Gen. MYSIA.

Mysia 15 *punctata,* Muls.
Coccinella 15 *punctata,* Oliv.
Anatis mali, Say.
A. labiculata, Ibid.

I have only taken one specimen of this insect.

ART. XIII. EXPLORATIONS IN THE PICTOU COAL FIELD, IN 1867 AND 1868. BY R. G. HALIBURTON, F. S. A., *Sec'y of Nova Scotia Coal Owners Association.*

(*Read Dec.* 14, 1868.)

SINCE my paper appeared in the Transactions for 1866–7, explorations in the Pictou coal field have been somewhat limited in consequence of the temporary depression which has taken place in the coal trade, the result of the heavy duty imposed by Congress upon our coal, and the low price of fuel in the United States.

On the Montreal and Pictou Company's property, on the west side of East River, expensive explorations were carried on, to thoroughly test the seam, for the purpose, if possible, of identifying it with the main or the deep seam of the Albion Mines. A level was driven one hundred yards westerly on the seam. As we worked westerly the partings gave out, and the benches united in one seam of 25 feet thickness, which improved in quality the farther west we worked. In Professor How's work on the Mineralogy of Nova Scotia, he gives to coal tested by him, which came from this seam, a high rank as a steam producer.* Dr. Dawson has also spoken to me of specimens which he has examined, as being unsurpassed by any which he had elsewhere met with in the Pictou coal field. The whole seam was not equally good, the fault having caused it to be disturbed, but it was rapidly becoming uniform in quality, as the levels were driven away from the fault which was found where the pit was sunk. At the end of our west level, we drove a level northerly through the underlying strata, and found them undisturbed. The Intercolonial Company also traced the crop of our seam nearly a quarter of a mile westerly into their area.

The general appearance of the Montreal and Pictou seam resembled greatly the Campbell seam, the main seam of the Middle River district; but there was a great difficulty in finding room for these seams as they approached the conglomerate, so we could only solve the difficulty by imagining that some faults would be found near New Glasgow.

In July, 1868, Dr. Dawson examined a large portion of the Pictou coal district, and among the rest the areas belonging to the East River Company, which adjoin the Montreal and Pictou Company's property, and extending back nearly three miles to "the Marsh," embrace the Geo. McKay or Marsh coal within their

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* Professor How gives the following analysis of this coal:

"No. 2 sample from second bench gave—

Moisture	5.47	
Volatile combustible	19.93	
Fixed carbon	68.55	Coke—74.60
Ash	6.05	
	100.00	
Evaporative power	9.41	

"This was an extremely bright and clean coal. Its very high evaporative power, even making allowance for the difference between the power shown by analysis, and that which could be actually obtained by practice, makes it occupy a good position among British and American Coals for Steam."

limits. The following extracts from a report by him may be of interest here:—

"The area of the East River Coal Company extends to the south-eastward from the town of New Glasgow, about three miles, with a breadth of about a half a mile, and lies in the northern and central portion of the Coal basin of the East River of Pictou, on the east side of that river.

"The workable seams contained in the property, consist of certain upper seams not known on the west side of the East River, together with the equivalents of the lower seams which have long been mined on the west side, though their extension on the east side of the Coal field has only recently attracted attention. In this report I shall notice these two groups of beds separately, and shall then refer to the extent and quantity of the Coal contained in them, and the most profitable means for its extraction.

"I.—UPPER COAL SEAMS.

"These upper beds crop out on the west end of the area with easterly dips. One of them, the "Stewart seam," has been opened in the adjoining property of the "General Mining Association," though the works are now abandoned. It is stated to be about three feet in thickness, its coal being of excellent quality. Its dip, as ascertained by examination of the associated beds exposed in the bed of "Potters Brook," is east at an angle of 40°. The strike of the "Stewart seam" carries it into the area of the East River Company; and following its direction a shaft has been sunk in the overlying measures, which has penetrated a bed of 2 feet 9 inches thick, known as the "Richardson seam."

"This may possibly be the continuation of the "Stewart seam," but is more probably an overlying bed. The "Richardson seam" is now worked on a small scale in connection with a bed of fireclay, which forms its floor. The dip at the Richardson mine is to the south-east, shewing that the measures turn somewhat rapidly to the eastward in the space between it and the old workings on the Stewart seam. Following the outcrop to the eastward, there are indications of a further bend of the measures to the east; but the coal is not seen for a mile, where a bed known as the "Foster seam" is exposed on an old adit, a short distance to the northward of the property of the Company. This bed is 4 feet 4 inches thick, and dips at a small angle to the north-east. In a short space, however, the dip of the measures changes, and a little to the northward a slope has been sunk by the Montreal and New Glasgow Company on a bed 4 feet thick, dipping south 5 degrees east, at an angle of 34°. This bed differs from the Foster seam in its character and accompaniments, and is probably an overlying seam. It has 6 inches of cannel in its upper part, and a larger per centage of ashes than the Foster seam, which is a good Coal of uniform quality. Trial pits opened in this vicinity, both in the Montreal and New Glasgow and East River areas, indicate that the beds have been subjected to an anticlinal fold, producing considerable disturbance in this part of the area, and probably dividing it into two subordinate basins. Beyond this place the coal outcrops have not been traced along the northern side of the area, but on the adjoining property and near the eastern end of the area, now under consideration, a bed of Coal has been struck by Mr. Kirby. It is stated to be 4 feet thick, and dips to the south, which would carry it in a short distance into the East River area. This bed is no doubt a continuation of one of those mentioned above, probably of the upper or Lawson seam.

"Returning to the south side of the area at its western end, the strike of the "Stewart" seam would carry its outcrop to the southward, and it does not appear on this property for some distance to the eastward.

"On the eastward end of the area, however, the outcrop of the upper seams again crosses the boundary of the area, and one of the beds 4 feet 4 inches thick has been opened, under the name of the "George McKay" seam, and a considerable quantity of excellent coal has been extracted from it. It has a high reputation as a steam coal, which, as will appear in the sequel, is borne out by its composition. It dips north 60° east at an angle of 12° to 15°. From this place the extension of the bed has been traced about 1104 feet, and a shaft has been sunk upon it by the "German Company." At the time of my visit, this shaft had penetrated three small seams of coal, and I was subsequently informed that it had also passed through a bed corresponding in size and quality with the Lawson seam before reaching the McKay bed, which would thus appear to be the Foster seam.

"The McKay bed would appear to be the lowest bed of the upper series, with the exception of a seam of 9 inches in thickness; but at a distance of 400 yards to the rise of the measures, corresponding to a vertical thickness of about 300 feet, there occurs a bed of oil coal 7 feet thick, of which 4 feet have been found to yield at the rate of 60 gallons per ton, and the remaining three at the rate of 40 gallons per ton.

"II.—Lower Seams.

"The equivalents of the "main seam" and other beds of the Albion Mines, occur on this property at a depth of about 1000 feet below the upper beds above mentioned; on the northern side of the area, and near its boundary, one of these beds has been opened in a trial pit, which was full of water at the time of my visit, but I was informed that it had exposed a bed of Coal six feet thick, S. 20° W. at an angle of 60°. This opening cannot, however, be considered sufficient to test this portion of the property, as the lower seams must, if one may judge from their dimensions elsewhere, be much more extensive than the above statement would indicate.

"On the north side of the area, the lower beds have not yet been removed, but the characteristic black shales which overlie them appear in several places, and they could, no doubt, be easily reached by a shaft sunk in the south-eastern part of the property. From my knowledge of other parts of the Pictou Coal field, I have no hesitation in affirming that these lower beds underlie the greater part of the area, and though they have not been proved, yet their ascertained value both to the west and east of the area, renders it certain that their amount of coal must greatly exceed that of the upper series above mentioned.

"III.—AMOUNT AND QUALITY OF COAL.

"It is not at present determined how many workable beds occur in the upper series; but it is certain that there are at least two: (1) The Kirby or Lawson seam, worked on the slope of the Montreal and New Glasgow Company, and which may be identical with the Richardson seam and with one of the beds on the shaft of the German Company. (2) The Foster seam, which I regard as identical with the George McKay, and possibly with the "Stewart" seam.

Samples of these Coals gave on assay, the following results:

Name of Coal.		*Volatile matter.*	*Coke.*	*Fixed Carbon.*	*Ash.*	*Color of ash.*
1. Kirby or Lawson, 4 feet thick.	coal	25·4	74.6	50	24·6	whitish.
	cannel	34.8	65.2	47.6	17.6	reddish.
2. George McKay, 4 ft. 4 in.	1 sample	31·4	68·6	63·6	5	grey.
	2 "	31·2	68·8	62.6	6·2	grey.
3. Foster Coal, 4 ft. 4 in.		29	71	53·4	17·6	reddish grey.

"Of the above coals, that of the George McKay seam is decidedly the most valuable, whether for gas or steam purposes. In the small amount of earthy matter contained in it, it compares favourably with any coal hitherto shipped from the Pictou mines.

"The coal of the Foster mine, in general quality, resembles that of the George McKay, but contains much more earthy matter. If as above conjectured, these two exposures belong to one and the same bed, then the quality of the coal must improve in its extension eastward.

"The Kirby or Lawson coal affords a large amount of ashes; but the layer of cannel at the top is very valuable as a gas coal, and affords a good coke.

"I had no opportunity of obtaining samples of the lower coals on this property. The nearest exposure to the opening already referred to on the north side of the area, is that of the Montreal and Pictou Company on the west side of the river, where the beds are stated to contain 37 ft. 6 in. in thickness of good coal in four beds. The nearest exposure to the eastward is that on the McBean area, where the thickness is believed to be sixteen feet in two beds.

"With regard to the actual quantity of coal on the area, the facts are not sufficiently well ascertained to enable a definite calculation to be made, I consider it palpable, however, that the upper seams will be found to extend over about one square mile of the area, and that after making all reasonable deductions, they may afford about 4,000,000 tons of coal at a very moderate expense for extraction and transportation. The lower seams must extend over nearly the whole extent of the property, and must be capable of yielding several times the above quantity."

Having had some experience of the difficulties which meet the geologist, and the practical miner in the Pictou coal field, from the remarkable features which it exhibits, I addressed a letter to the Secretary of State for the Provinces, and while in Ottawa in February 1868, had an interview with Sir John Macdonald, respecting the importance of having a geological examination of that district, as soon as possible by the Geological Survey of Canada. It was represented that the complicated nature of the coal formation there, as indicated in my last paper, was a source, not only of scientific uncertainty, but also of great difficulty and of a heavy loss in an economic point of view. This correspondence which has been published *in extenso* in our local papers, resulted in an assurance from the government that arrangements were being made for a Geological Survey of Nova Scotia, and that everything would be done to secure an early and a thorough investigation of the coal fields of Pictou county.

In the course of a few months, Sir Wm. Logan, accompanied by a very able assistant, Mr. Edward Hartley, visited Pictou county, and spent the summer and autumn in making a most careful and painstaking examination of that locality, and of its geological structure. The brief summary report of his survey which has appeared, will be of interest here :—

"The attention of Mr. D. Honeyman was applied in Nova Scotia to an examination of various parts of the townships of Maxwelton, Arisaig and Antigonish, in the counties of Pictou and Antigonish, especially those extending along the sea coast for a few miles inland, embracing rocks of the Silurian and Carboniferous eras. Belonging to the latter on both sides of Antigonish harbor, there are important deposits of gypsum, well situated for the purposes of trade ; and the recent investigations of Mr. Honeyman apppear to have considerably extended the surface under which the mineral was previously known to exist.

"In Nova Scotia I availed myself also for a short time of the services of Professor H. How of King's College, Windsor, whose attention was directed to various parts of the County of Digby, where the ores of iron with some indications of copper and lead seem to be the chief substances of economic interest.

"About three months of my own time have been occupied in the investigation of the structure of that part of the Pictou coal field in Nova Scotia, which lies southward of New Glasgow, and extends several miles on each side of the East River. In this I was aided by Mr. E. Hartley, and with the view of hastening the examination as much as possible, we divided the work into two parts. That on the west side of the river was wholly committed to Mr. Hartley, that on the east was undertaken by myself.

"The true structure of a coal field, in which valuable seams of the fuel exist, being a matter of great commercial importance, no pains should be spared in making it out ; but where as in the present instance it is of a

* The report appeared subsequently to the paper being read, but before publication of this volume of Transactions. It has therefore been added to the paper

complicated character, while natural exposures and crop workings are but few, it will demand much time to accumulate the number of facts required to arrive at a satisfactory conclusion. We do not pretend that in three months we have been able to accomplish our task, but it appears to me that we have added considerably to what was previously known and at a future time we hope still further to elucidate the subject.

"The New Glasgow productive coal measures appear to lie between two great up-throw faults, which are about three miles apart on the East River, and run nearly parallel to one another in a bearing northward of west. The coal field is about ten miles long between Middle and Sutherland Rivers, and it is broken by several obliquely transverse faults. The measures suffer some undulations, and in several parts the coal seams abut against the one bounding side fault or the other.

"On the west side of the East River, the principal coal bed, being the one on which are established the Albion, the Acadia, the Intercolonial and the Nova Scotia collieries, is called the main seam. It is about thirty-five feet thick at the first named colliery, and about twenty feet at the others. Beneath this there is a seam of twenty-four feet, one of five feet and one of eleven feet, all in a thickness of about 500; besides which about 200 feet lower, there is a four feet seam made up partly of coal and partly of a species of carbonaceous shale, yielding much oil by distillation, and formerly giving it great value.

"On the east side, besides an oil-shale seam of about four feet, on a different horizon however from the one just mentioned, there are among other coal seams of minor importance, one of four feet, one of six feet and one of eight feet, all of good quality, with others of inferior quality but greater thickness beneath. The most important of the whole is the eight feet seam, which exposed is of excellent quality, in its whole thickness. It has been only lately opened by Messrs. McBean on their three mile area, much of which it will underlie: the crop of it, having already, since I left Nova Scotia, been traced three quarters of a mile, running obliquely transverse between the two great upthrown faults mentioned.

"To elucidate the structure of this coal field a map is in preparation, but not yet completed, and when transmitted to the Government, it will be accompanied by reports, giving such details of structure as we have been able to collect, and in which we shall take the opportunity of thanking many persons for the information and assistance they have afforded. The reports will be accompanied by an appendix, giving in a tabulated form, analyses of various coal seams of this field, some of the analyses recently made, and others collected from different official sources, not now readily accessible, as well as information which could not be conveniently introduced into the body of the reports."

The heavy fault, detected by Sir Wm. Logan, is the key to the whole district. Its discovery was due to most exact and careful explorations, accompanied by an equally careful topographical survey, both of which were carried on by Sir Wm. Logan and Mr. Hartley. The enormous labour of pacing all the roads, and measuring and fixing all the localities where important exposures of strata occur, must be apparent to all. The maps of the country and the previous topographical surveys had been altogether unreliable, and the geological survey had therefore thrown upon it the toil of the pedestrian and of the land surveyor, with the mental labours of the geologist and the man of science.

The occurrence of the conglomerate at New Glasgow had been the *bête noir* of geologists. How it got there and to what age it belonged was a puzzle. The mystery was solved by Sir Wm. Logan discovering that an enormous fault of some thousands of feet, passes close to the conglomerate at New Glasgow, running a few degrees east of south for miles. It passes through the northern angle of the East River property, traversing the Montreal and New Glasgow, and the Merigomish areas, passing a short distance to the eastward of the pit at Sutherland's River, where it meets the older rocks of the McLennan's Mountain range, and terminates the limits of the coalfield in that direction. It is a very remarkable fault, as it has brought up rocks which are, I believe, looked upon as possibly silurian, and has placed them in immediate contact with the coal seams of the district, the latter in many cases running against or being cut off by the fault. This interesting discovery solved not only the problems as to the conglomerate, but also the practical difficulties we had met with, in determining the course of the coal seams on the Montreal and Pictou Company's property. The seams instead of bending to the eastward, and crossing the river, run northerly until they are cut off by the fault. This discovery will greatly increase the value of that property, and its extent of coal, which had been previously under-estimated. I have been urged by Mr. Hartley to sink a shaft, or a trial pit on the seam found close to the river bank, which was seven feet thick at the outcrop. But it now seems probable that it must be the main seam. If this is the case, the seam worked by us must be the deep or the Cage Pit seam. A seam of seven feet so near the river, must prove very valuable, but the discovery of the main seam within a few yards of a shipping place, and of the railway, would be of still greater importance in an economic point of view to those interested in the property—and would be of much geological interest in determining the position of the upper set of seams.

The discovery of the northern edge of the basin on the Montreal and Pictou Company's property, proves to be most interesting, for excepting in that locality, the northern crops have been cut off by the line of the fault. In that place the edge of the basin must have originally curved further towards the south than anywhere else, and hence has escaped from the effects of the line of fault which has elsewhere cut off the crops, and probably a large extension of the basin to the northward. By a fortunate chance we searched for the northern edge in the only place where there was the slightest chance of finding it. No amount of skill or capital expended elsewhere would have been of any avail, in searching for the northern outcrops of the Pictou basin. The discoveries made to the eastward have been mainly confined to explorations on the McBean area, on which several seams have been found. The 8 foot and 6 foot seam were discovered a short distance from the western boundary of the St. Lawrence area, and have been traced to that property. It is difficult to pronounce positively as to these seams. The 6 foot seam is by a very competent judge, supposed to be the "George McKay seam"—and I have been urged to sink a trial pit on the George McKay area, in which I am interested, to see if the 8 foot seam does not occur below the George McKay or Marsh seam; although the discovery of the McBean seam on that property would materially enhance its value. At present there are but few inducements to invest much money in boreholes and trial pits. A revival of trade will lead to renewed energy in explorations, and will contribute alike to the cause of science and of commerce.

The great depression caused by the duty on our coal imposed by the Congress of the United States, was very nearly ruinous to all owners of undeveloped properties, as it was impossible to sell or to realize even at a sacrifice. Hence those who had already spent large sums in developing and testing their mining areas, were precluded from doing anything further, until a revival of trade should give renewed confidence in mineral property in Nova Scotia. There are, however, indications of a speedy revival, in spite of the heavy duty, which amounts to almost the price of the coal at the pit's mouth, as the price of fuel is rapidly rising in the United States. If this continues it must once more throw open an almost unlimited market to our coal, while a reduction of the duty, which cannot be far distant, will make coal mining in Nova Scotia one of the most profitable branches of business on this side of the Atlantic.

We may therefore look forward to extensive operations in the Pictou coal field before long, that will throw much light on the geology of the district.

APPENDIX.

METEOROLOGICAL SUMMARY, 1868.

HALIFAX, NOVA SCOTIA. LAT. 44° 39′ 26° N. 63° 36′ 40° W. 130 FEET ABOVE SEA.

	Mean Cloud.	SNOW—Inches.		RAIN.		TEMPERATURE.					WIND.		Wet Days.	Fogs.	Hoar Frosts.	Aurora Boreaks.	Thunder and Lightning.	Lunar Halos.	Hail.	Rainbows.	Mean Temper. 6 years.
		Dry.	Melted.	Inches.	Hours.	Max.	Min.	Highest Daily Mean.	Lowest Daily Mean.	Mean.	Prev, Direction.	Mean Force.									
January	6.8	21.	2.02	1.28	96.3	38	—5	34.7	5.6	18.2	N. W.	2.8	19	0	3	0	0	0	0	0	21.63
February	6.4	14.2	1.28	2.11	38.4	47	—11	33.8	1.7	18.7	N. W.	2.9	19	0	0	0	0	0	0	0	23.32
March.........	6.2	4.5	.41	1.36	76.9	56	—2	44.6	9.3	29.3	N. W.	2.4	18	4	2	4	0	0	1	0	28.41
April	5.9	14.7	1.61	2.25	99.9	58	10	46.7	18.1	35.43	W.	2.9	16	5	3	4	0	0	0	0	37.76
May	7.3	inap.	inap	6.38	151.1	78.5	23	61.25	37.5	48.69	S. E.	1.9	19	14	0	1	0	1	1	0	47.74
June..........	6.9	....	....	5.18	97.	83.6	35.2	68.5	47.08	59.2	S. W.	1.9	14	9	2	2	3	0	0	0	60.23
July	6.2	....	....	1.02	29.7	87.4	45.9	74.08	60.67	66.53	S. W.	1.5	10	8	0	2	2	1	0	0	62.57
August........	5.7	....	....	3.6	62.	89	40.8	71.83	53.92	65.	S. W.	2.	14	10	0	3	2	1	0	0	63.55
September	7.3	....	....	5.55	111.	80.4	33.8	67.67	44.18	59.47	S. E.	2.1	18	5	2	2	4	0	0	0	57.44
October	5.5	2 5	.26	5.63	65.2	74.7	19.	61.92	26.67	44.31	N. W.	2.3	12	1	5	5	2	1	0	0	45.98
November	7.1	4.	.41	6.05	119.3	66.8	15.5	58.08	21.5	34.77	N. W.	2.9	14	5	5	2	0	1	0	1	38.64
December	7.6	20 5	2.19	1.39	32.4	43.8	1.7	38.34	11.58	24.98	N. W.	2.1	14	2	5	1	0	1	0	1	24.84
1868 Totals and Averages..	6.57	81.4	8.17	41.8	827.8	89	—11	74.08	1.7	42.12	N. W.	2.31	187	63	27	26	13	6	2	2	43.14

Notes on new points and corrections in Acadian Geology.

By J. W. Dawson, L. L. D., F. R. S., &c.

The matters referred to in this paper relate more or less directly to subjects noticed in the recently published edition of my "Acadian Geology," but it is not my purpose either to review my own book or to defend it from reviewers. It would be the less necessary to undertake the latter task since the book has on the whole been very mercifully treated by critics, while much friendly notice has been taken of it by men high in scientific position on both sides of the Atlantic. For all this I am grateful, but am not desirous to take any undue advantage of it. In this spirit I now propose to point out and correct some errors which I have myself detected, or which have been pointed out to me by others, and to add a few new facts which have come to my knowledge in course of the past summer.

One of the most remarkable developments of mining industry in British America, is that which has occurred within the last ten years in the coal-field of eastern Cape Breton. Districts which were a perfect wilderness have become studded with mining villages and opened out by numerous roads; wild and dangerous shores have been rendered accessible by the excavation of artificial harbours; and more than a dozen of new collieries have been opened and have been producing a larger amount of coal than that of any other coal district in Nova Scotia. The opening of these collieries and the surveys in connection with them have not only greatly enlarged our knowledge of the district, but have raised many questions as to the correspondence of particular beds of coal, of a very perplexing character, and which I found much difficulty in disposing of in such a way as to give any satisfaction to myself or to those of my friends interested in the matter, either on economical or geological grounds. I was therefore glad in the past summer to have the opportunity of exploring under favourable circumstances, and in company with Mr. Ross of the Victoria coal mine and Mr. Moseley of Sydney, the remarkable coast section on the south side of Sydney harbour between Low Point and the South West Bar, and which I believe exposes all or nearly all the workable coal seams known in eastern Cape Breton. The section, as exhibited on this coast, stands thus, in descending order:—

1.—"Carr" Seam	4 feet.
Sandstone, Shales, &c., about	429 feet.
2.—"Paint" Seam	13 feet 4 inches.
Sandstones, Shales, &c., about	216 feet.
3.—"Crandall" Seam	4 feet 4 inches.
Sandstones, Shales, &c., about	400 feet.
4.—"Ross" Seam	6 feet 7 inches.
Sandstones, Shales, &c., about	325 feet.
5.—"William Fraser" Seam	2 feet.
Sandstones, Shales, &c., about	112 feet.
6.—"Number Three" Seam	4 feet.
Sandstones, Shales, &c., about	138 feet.
7.—"H. McGillivray" Seam	5 feet.
Sandstones, Shales, &c	122 feet.

8.—"D. McGillivray" Seam .... 2 feet.
Sandstones, Shales, &c., about................1000 feet.
9.—"Fraser" Seam .... 6 feet.
Sandstones (Millstone Grit series.)

This fine series of coal-beds I believe to represent the whole of the workable beds known at North Sydney as well as those of Glace Bay and Cow Bay. The high angle of dip brings their outcrops nearer to one another than is usual in this district, and a good coast cliff and beach section enables them to be well studied. This section is the best guide I have seen to the vexed question as to the equivalents of the several coal-beds in the different mining areas of Cape Breton, but its application is by no means easy. On the south side of Sydney harbour the coal-beds above-mentioned dip about N 5° E at angles of 30° to 45°. On the opposite side of the harbour the corresponding beds dip to the north east at an angle of 10° or less. Consequently the beds, crowded together on the south side, spread out like a fan on the north side. In addition to this when we measure the thickness of the beds intervening between the several seams of coal, it is evident that they must vary greatly both in character and thickness within very short distances. Making due allowance for these differences, it would seem that the "Paint" seam of the above list must be the "Lloyd's Cove" seam of the North Sydney series and also the "Phelan" or "Phalen" seam of the Glace Bay series. In this case the main seam at North Sydney is equivalent to the Ross seam, which will be upon the horizon of certain lower beds known as the Spencer seam at Glace Bay, and which I believe are not yet worked in that region, and the whole of these beds must belong to the upper member of the middle coal measures, while the lower member of that series is represented in this section by one workable bed only, the Fraser seam, which seems to correspond to the Tracey seam on Miré Bay. Between the two, but more closely connected with the upper member, the Number Three and its associated small seams are on the horizon of the Gardiner seam, near Bridgeport, and its continuation northward to Mire. These facts so far modify my statements in Acadian Geology, as to remove the Millstone grit formation to a greater distance from the Sydney main seam than I had supposed, and to diminish somewhat the probable importance of the lower beds of coal underlying those worked at Glace Bay and Cow Bay, though it would still appear that these lower measures actually include the equivalents of the Sydney Main seam, the Gardiner seam, and the Fraser seam; the latter not being as yet known as North Sydney, aud being apparently below some of the beds at that place reckoned by Mr. Brown as millstone grit. To these points I may add the statement that in my sketch map, page 413, the strike of the beds at the east side of Sydney harbour should turn a little more to the south, and that the outcrops should be closer to each other; and that by an error in the engraving the town of Sydney is removed from its true position on the southern arm of the harbour to the south-west Bar. I am indebted to Mr. Moseley of Sydney for information bearing on some of these points.

Leaving these local details I may now refer to some curious fossil plants met with in the coal formation of Cape Breton, and deserving of record as additions to our knowledge of its Flora. Among the rarest of fossil plants in the coal rocks of Nova Scotia have hitherto been the trunks of tree ferns. The scattered fronds are sufficiently abundant, but trunks of arborescent species are seldom found. Mr. Poole's collections at Glace Bay enable me to add another fine species to the coal flora of Nova Scotia. It is a huge flattened stem, a foot or more in diameter, marked with many wrinkles over the whole surface, and with large distant oval leaf scars 1½ inch in diameter and three inches in length, to which large fronds must have been attached. It is a near ally of *Caulopteris Macrodiscus*, Sternberg, but has larger and more distant scars, more obtuse above. I would name it *Caulopteris Glacensis*. It belongs to the genus *Ptychopteris of* Corda. Another remarkable trunk which I found obscurely preserved in coarse sandstone at North Sydney, appears different from anything hitherto described. It seems to have had four vertical rows of scars, the form of which could not be made out; but I have little doubt that it belonged to an arborescent fern with a stem four inches in diameter aud several feet at least in height. Near an abandoned coal mine at Bridgeport I also found a fragment of one of these tree-ferns surrounded with aerial roots to which the name *Baronius* has been given, but not admitting of specific description.

As I have been able hitherto only to describe four species of trunks of tree ferns, these are considerable additions. Among other interesting specimens in the collection of Mr. Poole, I also saw the curious sigillaroid tree *Syringodendron cyelostigma*, Brongniart, and a species of sigillaria new to Nova Scotia and allied to *S. rugosa* of Brongniart, though scarcely sufficiently perfect for description. Another remarkable form collected by Mr. Poole is a flattened striated stem about an inch in width with two rows of punctiform marks at the sides and giving off alternate slightly curved branches, at right angles, and in one plane. It may have been the stipe of a fern, but is at present quite a problematical species.

Another interesting fossil observed at North Sydney, was an erect Sigillaria with that peculiar bulb-like enlargement of the base, figured by Steruberg on Plate XXXVIII. of his great work, but which I had not before seen, the sigillariæ found in Nova Scotia usually enlarging regularly toward the base in the manner of ordinary trees. This bulb-like appearance seemed to be a natural feature of the growth of the plant, which had the markings of *S reniformis*. Through the kindness of my friend Mr. Brown, of the Sydney colliery, the specimen was carefully taken down from the cliff, and forwarded to Montreal; and it now stands a column five feet in height, in the museum of McGill university.

In the past summer the Pictou coal area has had the advantage for the first time of a detailed survey under our ablest stratigraphieal geologist, the eminent head of the Geological Survey of Canada. The results are not yet published, but I believe they will contribute in a very important degree to the solution of many of those difficulties in the distribution of the coal beds, especially on the east side of the river. More especially the persevering labour of Sir William Logan has enabled him to trace what I could only vaguely characterize as the "line of fracture skirting the outcrop of the New Glasgow conglomerate," for a great distance, and to ascertain that it is of the nature of an important fault. He has also ascertained several other subordinate faults, and has accumulated a great mass of new facts bearing on the curves and flexures of the beds. When Sir William's map of his explorations shall be published, geologists will be able for the first time to appreciate fully the difficulties and anomalies of this remarkable coal district, so different in its features from the other coal regions of Acadia. Until we have Sir William's results it would be rash to attempt to add anything to what I have already ventured to say of this district. I have, however, to make a correction of an error, pointed out to me by Mr. Rutherford, in the thickness assigned to the coal-beds of the "Montreal and Pictou" Coal Company. The sectional list given in page 341 from Mr. R's. report, is stated to be taken at right angles to the horizon, but it seems that this was a misconception on my part, as it is really at right angles to the bedding, which makes a material difference in the actual thickness intended.

I was much struck when in Nova Scotia with the great mass of slate and other rocks exposed in the Pictou railway between East River and Truro; and suspect that rocks of Devonian age may yet be found to be represented in this district, as well as those of the Silurian period. I also had the opportunity to examine the new gold region of Mt. Uniacke, and to make some interesting notes as to the features of its gold veins; but I must defer these to some future occasion. I may merely state that I saw no reason to depart from the view of the structure and origin of the gold veins, stated in my work, and which I think has been strengthened by the recent interesting observations communicated to the Royal Society by Mr. T. A. Phillips, on the nature and origin of the gold veins of California, which though much more recent than these of Nova Scotia, and indeed in some places actually in course of formation, must resemble our gold mines in structure and contents. The peculiar features of the Mount Uniacke veins do not imply any different mode of formation from those at Waverley and Montague; but I observed in addition to the banded "leads" interstratified in the almost vertical beds, one remarkable instance of a true fissure vein of auriferous quartz. I also noticed in the veins parallel to the bedding, several appearances indicative of aqueous infiltration rather than sedimentary deposition. I had hoped to have taken time to make farther explorations in the gold districts, with the view of satisfying myself more fully as to the alleged connection of the gold veins with anticlinal lines, and the reasons of this, if really a general fact; but the time at my disposal proved altogether insufficient, and I was obliged again to defer the discussion of this point, which I had found it necessary, for similar reasons, to pass over with a mere notice of Mr. Campbell's observations on it, in the chapter on the Gold region in "Acadian Geology." The geological survey, which has already, in the excellent report of Mr. Hunt, given a very good account of the gold regions, may perhaps follow up this part of the subject in its explorations of next summer. I may add that all that I have seen tends to confirm the high opinion which I have elsewhere expressed of the extent and value of the auriferous veins of Nova Scotia, and my belief that a much larger amount of capital than at present might be profitably expended in their exploitation, both in the larger extension of the workings in many of the areas now known to be productive, and in the opening up of new districts.

On an important Reclamation of Land near Sackville, N. B. By R. Carr Harris.

(Communicated by R. G. Haliburton)

While engaged as working Railway Engineer during April and May of the present year, I felt professionally interested in the tidal phenomena of the Bay of Fundy, and its connection with the formation of Dyke lands. I was struck with the remarkable work progressing on the Sackville marshes, and was glad to take advantge of a day while waiting for the Steamer *Gaspe*, to drive and walk over (with a good guide) as much of the marsh as possible in my very limited time.

I took notes at the time on points of professional interest, without the least idea of ever sending anything to the N. S. Institute of Natural Science, but I now send them with a few remarks which I think may prove interesting.

The extensive salt marshes near the lower parts of the Sackville and Tantramar Rivers have been for a long time dyked. Higher up the Sackville River and beyond the limits of the original dyked marsh, there used to be very wide expanses of bogs and shallow fresh-water lakes draining into the river. These waste areas originally covered many square miles and were quite worthless. However, they are now year by year being turned into solid land (salt marsh) by a persevering direction of the energies of the high tides of the Bay of Fundy. By "leading" ditches, the salt water charged with its well known mud, is being conducted into the fresh-water area. The fresh-water lakes are being choked with 5 and 6 feet of solid mud. Bogs of at least 3 and 4 feet depth of peaty matter are overflowed by the tide, layer on layer of sediment deposited, and finally the bog is crushed down close and dense by a surface deposit of from 1 to 2 feet of mud, on which hay grows luxuriantly. "High mosses" whose surfaces are above the high tide level are soaked by the salt water which rots them, the moss shrinks together and sinks down, the tides overflow progressively on the edges, and then they also are overlaid by the salt mud, which crushes them down.

To sum up, miles of fresh-water wastes, once desolate, are now covered with hay waist high, growing on a solid bed of tidal mud; much of this has now to be dyked, and all can be overflowed at pleasure. The work has been going on for years—and thousands of acres have been "made." It is going on now and may continue for twenty years more, for as moss after moss is overlaid, and lake after lake filled, the ditches are lengthened and fresh fields entered on. Roughly speaking, from a casual view of the place, there appears yet as much bog and lake to reclaim as has been done already. Works such as this, are of great engineering interest, however quietly carried on or simply effected, all the more so because beyond the surface-simplicity of the means used several questions present themselves, by no means easy to be answered without thinking, and which deserve to be investigated.

The means by which this reclamation is operated, are the widening and straightening of the original channels from the lakes to the rivers, and the digging of leading ditches to conduct the salt water in during high tide, and what is equally necessary, to drain the fresh-water off during low tide.

The most important of the works is the "floating ditch," this is a cut-off, or shortening of the main outlet channel from the lakes. Begun over twenty years ago, two and a half miles of it were dug by spade to a width of about nine feet. In consequence of the very important effects it produced, it has been gradually enlarged to the dimensions of a canal. It is now said to be 60 feet wide (though I judged it only 50 feet,) and very deep. This ditch was originally dug through a bog of six or seven feet deep. The bog was cut into blocks, with scythe blades cutting vertically, and then floated away—hence its name. I visited it at low tide; the bog matter is now covered with from 1½ to 3 feet of new mud, and is compressed to nearly half its original thickness.

To reclaim a piece of bog, a ditch is dug to conduct the tide water from the main channel through it, shallow side ditches are dug at right angles to this, at intervals of from 20 to 30 feet; the overflow of these at high tides does the work. The lakes are said to be much more quickly filled than the bogs

To illustrate the rate of progress, I will give the following fact which was related to me by my guide (Mr. Robert Towse, of "Towse's Inn.") In marking out by stakes the place for a leading ditch, by which he proposed to reclaim an area of bog and lake belonging to himself, he was necessitated to use a canoe holding two men, to cross part of the lake. Thirteen months afterwards, he actually drove a yoke of oxen with a load, over the same spot which the canoe passed over.

Underneath the mosses and marshes is invariably to be found a thick bed of mud, which the natives say is old tidal mud. This sub-mud is blueish in color and of fine consistency. The recent tidal deposits is of a brownish color, both are full of glittering specks. I send specimens of both. The sub-mud underlies the whole area, it is found at very variable depths from the surface. The section of the sub-mud as exposed for 2½ miles in the "floatihg ditch," is undulating like the section of an ordinary flat in a tidal river. If this mud is really of tidal origin, some cause must have arrested the ancient tides and given their sands to the action of the fresh water.

Certain questions arise:—

1st.—How can it be that fresh water lakes of wide expanse, possessing original uninterrupted communication with the Bay, through their outlet creeks, can be flooded with the Bay salt water by the apparently simple means of widening and shortening these channels?

2nd.—Is the elevation of the high water mark of any particular tide, higher at the upper extremity of these artificial channels, than it is in the river, *i. e.* can there be produced by the art of man on a small scale, the same effect by these long leading ditches, which is produced by the Bay tides in the Bay itself. *There* the tidal wave rushing up the continually narrowing Bay, piles the water at the head prodigiously, to the extent of 30 and 40 feet?

3rd.—If the sub-mud is really tidal mud, from what cause has the tidal overflow of these flats been suspended for such a long period, as to allow of the growth of the overlying bogs?

4th.—Must not the tides of the present time be higher than the ancient ones, seeing that they are depositing mud four or five feet above the level of the sub-mud?

Regarding No. 1. It may be observed, that the straightening of the channels operates powerfully in two ways: first, to drain off the fresh water during the low tides, much quicker than formerly, and thereby the old fresh-water level is greatly lowered; second, it must be remembered, that as the height of the tidal wave lasts only a short time, the shortening of the channel which it follows, enables it to reach a further limit before its rush is spent. Straightening the channel, saves momentum in the tidal flow. Shortening saves time and momentum also. By widening and deepening, a greater quantity of water is passed to and fro, thereby hastening the effects. A fuller and bolder application of these principles on these marshes, may in future times produce much greater effects.

Regarding No. 2. It may be observed, that apparently the only possibility of the water rising higher in the ditches than in the Bay, is the momentum of the tidal stream of water running up the river and the floating ditch—in all six or seven miles in length. The best means to decide this point, that is, whether the water piles at the heads of the ditches, would be to run a chain of levels instrumentally between two test points. In this connection, it is important to remember that there can be but little doubt that the elevation of the "made land" at the head of the ditches, is higher than that of the dyked lands further down the river.

I would suggest that the explanation of No. 4 is, that the Bay of Fundy is silting up, more especially at its head. The enormous quantity of mud in its waters, is supplied by the waste of the high bluffs of soft material along its coast. Their substance is continually being distributed in the Bay; continually being deposited in various parts, more noticably (as regards the finer components) on the flats at the heads of the inlets.

But as the same quantity of water continues to be caught by its flaring shaped mouth, and the same mechanical causes still pile the water at the head of the Bay, which we have surmised to be silting up, it would follow that the tides would rise gradually to higher limits.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. II. PART IV.

ANNIVERSARY MEETING.

IN accordance with the By-Laws of this Institute, the Anniversary Meeting was held on Wednesday, October 13, 1869, 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., DR. LAWSON.

Treasurer—W. C. SILVER.

Hon. Secretary—W. GOSSIP.

Council—DR. DEWOLFE, F. ALLISON, T. F. KNIGHT, J. RUTHERFORD, R. G. HALIBURTON, JOHN BELL, P. S. HAMILTON, A. DOWNS.

ORDINARY MEETING, NOVEMBER 8, 1869.

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

DR. J. B. GILPIN read a paper "*On the Mammalia of Nova Scotia,*" which included the Wood Chuck (*Arctomys monax,*) Beaver (*Castor Canadensis,*) Jumping Mouse (*Jaculus Hudsonius,*) Black Rat (*Mus rattus,*) White-footed Mouse (*Hesperomys leucopus,*) Hamster (*H. myoides,*) Gapper's Mouse (*Arvicola Gapperi,*) Field Vole (*A. riparia.*) (*See Transactions.*)

The paper was effectually illustrated by life-like drawings of each species.

In the discussion which ensued it was stated that, some few years ago, in a particular District of Prince Edward Island, there appeared a vast army of Field mice, which literally swarmed in every part of that locality, causing great alarm among the inhabitants. In such a grain growing island of small size, a visitation of these animals might be looked upon as a calamity, for the amount of food consumed and damaged by them would be very large.

A curious anecdote illustrative of the habits of the common rat (*Mus decumanus,*) was thus narrated by a member. M. Challoner, Chemist, at St. John, N. B., had a glass globe containing specimens of brook trout in his window, and one morning on entering his shop perceived that three or four of them had disappeared. On searching around he observed the tracks made by the depredators in carrying off the fish. Rats had been the offenders, and they had exhibited instinctive powers akin to reason, for, to the other end of the shop, where, on a lower shelf, had been placed an unprotected jar of syrup, the tracks were traced, and ample evidence in the shape of broken fish remains, thoroughly convinced the proprietor that the rats had dipped the fish into the saccharine mass, before eating, by way of a relish.

MR. R. S. HALIBURTON, F. S. A., read a paper "*On the Traditions of Nations.*" (*See Transactions.*)

ORDINARY MEETING, DECEMBER 13, 1869.

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

The PRESIDENT brought to the notice of the Meeting the very acceptable present of the first four volumes of Agassiz's "Contributions to the Natural History of the United States," the gift of P. C. Hill, Esq., a member of the Institute, and also a collection of heads, horns, &c., of Indian mammals, presented by Lieut.-Col. L'Estrange, R. A., which included a fine pair of Ibex antlers, and a head of the Indian Crocodile.

PROFESSOR LAWSON read a paper "*On the Ranunculaceæ of the Canadian Dominion.*" (*See Transactions.*)

The PRESIDENT read a paper "*On the Laridæ of the Nova Scotian Coast.*" (*See Transactions.*)

Lieut. C. B. MYERS, Bombay Staff Corps, who was present as a visitor, exhibited a fine skin of the Abyssinian Monkey, recently obtained in that country, (*Colobus Guereza.*)

ORDINARY MEETING, JANUARY 10, 1870.

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

MR. H. Y. HIND read a paper "*On the Laurentian Rocks.*" (*See Transactions.*)

PROFESSOR LAWSON read a paper "*On the Laminariaceæ,*" descriptive of species occurring in different localities of the coasts of British North America. (*See Transactions.*)

ORDINARY MEETING, FEBRUARY 14, 1870.

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

REV. J. AMBROSE read a paper "*On the effect of Atmospheric changes upon Animals.*" (*See Transactions.*)

Several members adduced additional facts confirming the author's views in regard to the subject.

A paper by MR. A. S. FOORD "*On Agates,*" was read by DR. HONEYMAN, F. G. S., embracing the several varieties found in the Bay of Fundy Trap formation. Several coloured drawings illustrated the paper. (*See Transactions.*)

ORDINARY MEETING, MARCH 14, 1870.

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

DR. HONEYMAN, F. G. S., read a paper, "*Notes on Iron Deposits on East River, Pictou, N. S.*" (*See Transactions.*)

A paper by MR. HENRY POOLE, "*On Meteorology of the Caledonia Coal Mines, Glace Bay, Cape Breton,*" was read by MR. FREDERICK ALLISON. (*See Transactions.*)

Mr. J. ROUE exhibited a very fine specimen of the Short-eared Owl (*Strix brachyotus.*) It was taken at Devil's Island, at the mouth of Halifax harbour, in a very exhausted condition.

The President called attention to some examples of water-worn stones, lying on the table, which he had obtained on the shingle beach at Point Pleasant. He remarked their likeness to certain stone implements used by the Indian tribes of olden times, now obtained in the Kjoekkenmoedding of the coast, and expressed his belief that it was the custom of the Indians to search for such stones, and with little labour transform them into axes, hammers, &c., which, if a correct idea, would set aside the impression that the old Indians were a very persevering race in regard to the manufacture of such implements, supposed to be the result of months of laborious handiwork.

Ordinary Meeting, April 11, 1870.

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

J. Bernard Gilpin, M. D., read a paper "*On the Musquash* (*Fiber zibethicus.*) (*See Transactions*) which was illustrated by several excellent coloured drawings of the animal, its lake dwelling, &c.

Mr. Augustus Allison related an anecdote concerning the Muskrat. He was out with an Indian in the forest, when they came suddenly on the shore of a lake where two rats were running about near the water's edge. Halting immediately, the Indian made a peculiar noise with his lips which brought the animals up to the place where they were concealed, so well had the Indian hunter imitated their natural call.

The President read a paper entitled "*Notes on the Marine Zoology of Nova Scotia.*" (*See Transactions.*)

Mr. Augustus Allison offered some remarks in regard to one species mentioned in the above paper. It was the *Limnoria terebrans.* It was its habit to bore more particularly into that part of the wooden wharf-piles which was at half-tide mark, and, in consequence, that portion of the piles, after the drift ice had been rubbing against it through the winter season, became fretted away, and the pile presented the shape of an hour glass.

Ordinary Meeting, May 9, 1870.

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

Mr. Frederick Allison read a paper entitled "*Meteorological Observations at Halifax, Nova Scotia.*" (*See Transactions.*)

Dr. Gilpin read a paper "*On the Porcupine,*" (*Hystrix dorsata.*) (*See Transactions.*)

Dr. A. C. Cogswell presented, on behalf of Professor McQuillen, of the Philadelphia Dental College, several mounted specimens of *Trichina spiralis.*

BOOKS, PAMPHLETS, ETC.,

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ASTRONOMY.—Observational Astronomy and Guide to the use of the Telescope. 1 vol., 8 vo., cloth.—*Presented by Lieut.-Col. H. Austen.*

ARCHÆOLOGY.—Description of Ancient Sepulchral Mounds, at Newark, Ohio. By O. C. Marsh. Pamphlet, 1866.—*Presented by the Author.*

BAMBERG.—Funfter Bericht der Naturforschenden Gesellschaft. Fur de Jahr, 1860-1. 1 vol., 8vo., paper. Fur de Jahr, 1861-8. 3 parts. Ueber das Bestchen und Wirken der Naturforschenden Gesellschaft. Vierter Bericht, 1859. Pamphlet, 4 to.—*Presented by the Society.*

BELT, THOMAS.—Formation of Lakes by Ice action. Pamphlet, 8 vo., 1864.—*Presented by the Author.*

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CANADA.—Geological Survey of Canada.

Report of the Survey, 1863. 1 vol., 8vo., cloth.

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Catalogue of Silurian Fossils of Isle of Anticosti. By E. Billings. Pamphlet, 8vo.

Report of Progress of the Survey from 1863 to 1866.

Notes on Iron and Iron Ores. By Dr. Sterry Hunt, F. R. S. Pamphlet, 8vo., 1870.

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COLLET, ROBERT.—Norges Fugle, og deres Geographiske udbredelse i laudet. Af Robert Collet, 1868.—*Presented by the Royal University of Norway.*

CHEVALLIER, E.—Manual of the Ancient History of the East. By Francis Lenormant and E. Chevallier. Vols. I., II.—*Presented by E. Chevallier.*

CONCHOLOGY.—Remarks on the Classification of North American Helices. By Thomas Bland. Pamphlet, 8 vo., 1863.

On the Geographical Distribution of the genera and species of Land Shells of the West India Islands. By Thomas Bland. Pamphlet, 8 vo., 1861.

Remarks on certain species of North American Helicidæ, with descriptions of new species. By Thomas Bland. Part I, 1858. Part II, 1860. Part III, 1862.

DUMFRIES, SCOTLAND.—Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society, 1863-4.—*Presented by the Society.*

ENTOMOLOGY.—Correspondence of Thaddeus M. Harris, author of, "Insects Injurious to Vegetation." 1 vol., 8vo., cloth.

Natural History of the State of New York. Part V., Insects Injurious to Agriculture. By E. Emmons. 1 vol., 4 to., cloth, gilt.—*Presented by Capt. C. Hardy, R. A.*

Notes on some species of the Humble Bees of New England. By Messrs. Putnam and Packard, 1865. Pamphlet, 8 vo.—*Presented by the Authors.*

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Annual Report, 1869. By E. T. Cox. 8 vo., cloth.

Maps and Coloured Sections referred to in above Report. Portfolio.—*Presented by the Survey.*

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On the Sandstone of Vermont, U. S. By the Rev. J. Perry. Pamphlet, 8 vo., 1868.—*Presented by the Author.*

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MAURY, M. F.—Physical Geography of the Sea. 1 vol., 8 vo., cloth.—*Presented by Lieut.-Col. Austen.*

MAMMALIA.—The Morphology and Teleology of the Mammalia, 1865. By Burt G. Wilder. Pamphlet, 4 to.—*Presented by the Author.*

MANCHESTER, G. B.—Report of Scientific Students' Association, 1865-6-7. Pamphlet, 8 vo.—*Presented by the Association.*

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SARS, M.—Memoires pour servir a la connaissance des Crinoids vivants. Par Michael Sars, 1868.

Fortsatte Bemœrkninger, over det dyriske livs ud bredning i Havets dybder. Par Michael Sars, 1868.

SARS, G. O.—Om individuelle variationer hos korhvalerne og de deraf betingede uligheder i den ydre og indre Bygning. Par G. O. Sars, 1868.

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The Tasmania Journal of Natural Science, 1842.—*Presented by Capt. Lyttleton.*

TELEGRAPHY.—Allan's System of Ocean Telegraphy, 1858-67. Pamphlet, 8 vo.—*Presented by Capt. C. L'Estrange, R. A.*

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ZOOLOGY.—Journal of Linnæan Society of London. Zoological Section. Vols. VII., VIII., IX., X.

Zoological Nomenclature. By Sir W. Jardine, F. R. S.—*Presented by the Author.*

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. VI.

(*Read November*, 1869.)

THE AMERICAN BEAVER.

THOSE who did me the honor to listen to my last paper, will recollect that taking them in their proper order, I described the bear, the group of squirrels, both ground, tree, and flying, and the marmot, or woodchuck inhabiting our Province. This evening's paper will be given to the beaver, and the family of mice either introduced or indigenous.

Castor, *Canadensis*, (Kuhl, 1820. Baird.)
Castor, *Fiber*, (Linn. Audubon. Bachman.)
Castor, *Fiber—variety Americanus*—(Richardson.)
Castor, *Americanus*. (Fred. Cuvier, 1821.)

These synonyms show that from Linnæus, down to 1820, the American beaver was considered identical with the European, Kuhl at that date showed osteological differences which were at once recognised by naturalists as a difference in species. Cuvier followed in 1821, but giving the specific, *Americanus*. The law of priority, however, must give it to Kuhl.

These osteological differences are in the relative length of the bones of the nose, which are produced much farther back, in fact are longer than in the American, making in the European animal a much broader head. The castor bag in the American is smaller, the skin thinner, and the castoreum of amber colour, when kept a long time, and not waxy and lustreless as in the European.

I have no specimens of the Nova Scotia beaver before me, having only seen such captured ones as were kept in confinement by Messrs. Downs and Leahy, but which are now dead. Therefore any description of them would be only repeating the observations of others. In confinement, they seem inert masses of fat, both crabbed and stupid, and not exhibiting their conventional sagacity. By early voyagers their numbers were said to be immense and their skins used to warm the living and shroud the dead. Even now, the grave of some warrior is yet turned up by the plough, and his bones with his stone spear, and jasper arrow heads are found resting in a fluffy bed of decomposed beaver skin wrapped in that almost incorruptible shroud of birch bark. They are now extinct in the eastern part of this Province, and were so nearly so in the western part, that some thirty years ago old hunter Hardwick was supposed to have trapped the last. They have, however, wonderfully revived of late years, and three or four hundred skins are annually exported from Halifax. The streams that flow from the great swampy lake basin forming the interior of the southern and western portion of the Province, are now frequently adorned by their dams and houses, so that a naturalist from Boston or New York might find himself in forty-eight hours, floating on a sluggish streamlet down to the waters of the great Rosignol, and hear his Indian say, "There beaver house," as he passes a low flattened cone of sticks and mud standing in and out the shallow waters. For a description of these, as well as the dams, with sectional measurements, I beg to refer you to a paper of Capt. C. Hardy, R. A., published in our "Transactions," and also to the beautiful model presented by him to this Institute, copies of which were exhibited at the Paris Exposition, and are also in the possession of the Halifax Museum, and the Zoological Society of London. These leave nothing to be said or seen on the subject.

The older naturalists put the muskrat next to the beaver in their systems. The later, and especially the American authorities, whom we follow, have placed him after the mice, placing him after the short-tailed mice or voles; whilst the former had a regard to his appearance, his habits of construction, his hind legs, and his tail, both of which approximate nearer to the beaver than any known animal, the latter taking the anatomical difference in form of skull and construction of teeth, in all which he resembles the voles, have placed him after them. I merely mention this before taking up the family of mice, to make the article complete, and with no intention of remarking upon it, being well aware that original observations are the only ones worth anything by an amateur.

In Nova Scotia we find no connecting link between the beaver and the family of mice, excepting the very beautiful Jaculus or jumping mouse, which was formerly included with the mice. We have no gophers, or pouched rats, as in Western Canada, where several species exist under the trivial names of salamander rats, and pouched rats. American Fauna seems to have extended itself north and south, and the reverse, rarely do you find species identical east and west, with the exception of certain circumpolar animals which seem to have descended simultaneously both east and west.

We thus come next to the genus *Jaculus* having only one species representing it in North America—allied in form to the *Jerboa* of Europe.

Jumping Mouse.

Jaculus, Hudsonius. (Temm, Baird.)
Dipus, Hudsonius. (Zimm, 1780.)
Meriones, Hudsonius. (Audubon, Bachman.)
Meriones, Labradorius. (Richardson.)
Meriones, Acadicus. (Dawson.)
Labrador Rat. (Pennant.)
Gerbillus, Canadensis. (Godman.)

A beautiful specimen of this little animal lies before me :—

Extreme length..................................$8\frac{1}{8}$ inches.
Length of tail......................................$5\frac{1}{8}$ inches.
Length of hind leg from heel to toe..........$7\frac{1}{8}$ inches.

Colour dusky on the back reaching down to a line from tip of nose to tail, over a beautiful wash of yellow rusty. This yellow becomes brighter upon the flanks, and gives a fine yellow border to the white of the belly; chin, belly, and all below white, with a tinge of yellow. The darker colour of the back is formed by longish dark hairs which disappear upon the sides. The tail is naked, annulated, dusky above, white below, ending in a fine pencil. The feet are clothed with fine silky whitish hair, the soles dark, the palms rose colour; the whole hind heel is naked. The ears are dusky, with light margins, covered by thin hairs outside and partially inside. His form in repose shows an arched and rather blunted nose, a humped back, and thighs and legs disportionately long for the fore ones.

I watched one at St. Clement's, N. S., August, 1863. His leaps were so frog-like that had it not been for the colour, I should have passed it as one. The leap was, however, something more undulatory, more gliding and graceful. It was not at all like the conventional figure of Landseer, (*Fauna Borealis*,) which has been copied by all writers, and which represents the animal flying at an angle of 30° with the horizon. These leaps were scarcely more than horizontal. It reposed upon the branch of a dead tree, ears close, head and nose horizontal, feet concealed and back humped.

I subsequently kept one for a few weeks. It showed little docility, became soon dull, sleeping continually until it died. As it was in November I thought it was hybernating, but it proved the sleep of death. It ate its food sitting upon its haunches, but not very erect, and always held it between the back of both fore paws, (its knuckles, as it were,) and not by the palms. I have noticed this in all rats, mice, and squirrels I have watched, notwithstanding the very high authority against me in the exquisite print of "The Nut Crackers." Bears, marmots, porcupines, beavers and muskrats, use the palms as we do, though they all do not possess clavicles. In winter this beautiful little animal burrows a round hole in the ground, lines it with grass and moss, contrives to get into it, and from the inside to weave so tight a ball about himself, that it will roll upon the ground, himself inside. Here he hybernates a foot below the surface, and from hence awaking from his winter's sleep he digs his way out. They are far from rare in the Province.

In the family of mice this Province cannot be said to be well represented. It is not arctic enough to have the vast hordes of lemming and hamsters, neither is it genial enough for the numerous and more southern species. With all the world she has her three representatives of introduced species, the brown and black rat, and the common mouse, all true *mures*. Indigenous to her we have two long-tailed mice, the white-footed, and the hamster mouse, and two voles or short-tailed ones, at least I have identified but these, I earnestly hope every member of the Institute would forward any specimens of mice they may obtain, as the settlers in the woods name two or three more kinds, and some new specimens have been found in the islands on the Atlantic coast, in the neighbouring States.

I think the Tusket, Mud Islands, and Cape Sable Island, off Yarmouth, might be found to contain some.

Brown Rat.

Mus. decumanus. (Pallas, Dekay, Audubon, Bachman.)
Mus. Norvegicus. (Erxlebein.)
Norway Rat. (Pennant.)

Nothing need be said of this cosmopolite, except that he is found in all parts of the Province, affecting rather the sea coast than the interior.

Black Rat.

Mus. rattus. (Linn., Dekay, Audubon, Bachman.)
Mus. Americanus. (Dekay.)

As I have only obtained four specimens of this animal, I have found him very rare here, as I believe he is elsewhere becoming. One was a mounted one by Mr. Downs, the skins of two others procured by myself are respectively in the Smithsonian Museum and in that of J. M. Jones. A fourth was given me by J. R. Willis, Esq.

Measurement of *M. rattus*, picked up by myself in Water Street, Halifax, and just killed out of a trap by a terrier, 1863 :—

Entire length	$14\frac{2}{10}$ inches.
Length of tail	$7\frac{7}{10}$ inches.
Hind heel to end of toe	$1\frac{3}{10}$ inches.
Height of ear	$0\frac{6}{10}$ inch.

Colour, shiny blue-black on head, forehead, back, and one-third down the sides; under parts bluish-ash; feet and legs covered by short glistening bluish-ash hair; palms and soles, pale flesh or rose tint; tail annulated, naked or covered with very fine hair, with a small thin pencil. There were five tubercles on the palms, and six upon the soles, two at root of middle toes, one at root of outside and inside toe each, and two disposed diagonally along the sole. The palms and soles were very thick and fleshy. There were four toes and a rudimentary thumb, (the nail of which was scarce perceptible) on the fore foot, and five upon the hind. The ear was large rounded, the anterior edge folded inward, the posterior edge outward, and backward; the entire ear naked, but under a strong glass, shewing scattered hairs; the nose was more pointed, head smaller, fur finer than *Decumanus*, having fewer of those coarse long hairs than the latter has; the nails were long and sharp; the hind toes very long, the three middle ones the longest and nearly equal, the inner one slightly shorter than the outside one, and both much shorter than the middle ones; the whiskers were about two inches long and deep shiny black. The specimen given me by J. R. Willis was taken in Jacob's Lane, Halifax, 1869, and measured—

Length of body	$6\frac{6}{10}$ inches.
Length of tail	$5\frac{7}{10}$ inches.
Heel to end of toe	$1\frac{5}{10}$ inches.
Height of ear	$0\frac{6}{10}$ inch.

It thus differed in having a longer heel. The tail was shortened by disease; the whole appearance sickly, and colour dull sooty black. On examination, one of the lower incisors had overgrown, and had entered the palate at the root of the upper incisor, causing no doubt great pain in eating.

As these rats are becoming so rare I thought it best to give the most minute account of them I could. I believe they are more abundant in the West India Islands. Our stevedores tell me that in smoking vessels from the West Indies to clear them of rats, they usually find them all black.

Common Mouse.

Mus Musculus. (Linn.)

Like the Norway or brown rat, this sprightly cosmopolite has been introduced into all lands. In comparing many specimens I found they differed as to length of tail. They abound often in old grist mills built on the edge of the forest, and turned by some mountain streamlet. Here they obtain to such a size and have such a soft creamy wash over their brown skins that would almost make a permanent variety. Isolation and abundance of food cause no doubt these differences. We come now to our indigenous species.

White-footed Mouse.

Hesperomys, leucopus. (Baird, LeConte.)
Musculus, leucopus. (Rafinesque.)
Mus leucopus. (Dekay, Bachman, Audubon.)
Mus agrarius, Americanus. (Linnæus.)

I have chosen four synonyms out of about fifteen with which this little animal has been honoured, and those of the best American and European naturalists. From a specimen before me given me by Mr. Downs, Dec. 19th, 1863—

Extreme length	$6\frac{1}{4}$ inches.
Length of tail	$2\frac{1}{2}$ inches.

In colour it is brown with a yellow wash above a line drawn from the tip of the nose along the sides and running down to the front of thighs, along which to the hind leg; all below this is pure white, the feet and toes pale pink; a streak commencing between the ears of dusky passes down the back widening above the flank towards the tail; tail brown above, white beneath, and well clothed with hair; whiskers long, both white aud black; ears very long, rounded, dusky, with a small white rim, and naked inside and out; the forehead was very arched; ears prominent and eyes full.

This mouse does not hybernate, this specimen having been taken abroad in December. Mr. James Melville also informed me that on 17th January, 1863, he cut and hauled from the forest a stick of timber for fire wood; in cross cutting it with a saw, he came upon a hollow lined with vegetable down from a shrub common in the swamps, also other hollows not lined, but filled by a pint and half of pine and fir seeds. Out of the lined nest two white-footed mice crept and were agile enough to escape his pursuit. It seems nothing but the invasion of sharp steel in their comfortable quarters ejected them; the rough hauling from the forest they seemed to have withstood. Thus, constructing their nests on trees they frequent the open, and enter settlers' houses where they are trapped like the house mouse.

Hamster Mouse.

Hesperomys, *Myoides*. (Baird.)
Cricetus, *Myoides*. (Gapper.)

In examining specimens I frequently found some white-footed mice with longer tails than others, and with a faint ash colour over the yellow brown. I confounded them together, until my attention was called to the subject in the article on *Hesperomys*, in Baird's Mammals of North America. The following is a description of one given me by Mr. Downs in February, 1864, which differed from *leucopus* in having cheek pouches and a longer tail:—

Extreme length	$7\frac{9}{10}$	inches.
Length of tail	$3\frac{7}{10}$	inches.
Length of hind foot	$\frac{8}{10}$	inches.
Height of ears	$\frac{5}{10}$	inch.

Colour below a line drawn irregularly from point of nose along the cheek, shoulder, side and front of thigh, white; above this line yellowish brown, brighter on the cheek and sides; along forehead, back and rump dusky; feet pale pink and clothed with short silky hair; tail dusky above, white below and covered with white short hairs, with a pencil; ears dusky with a narrow white rim; the cheek pouches extended nearly to the ear, lined with a pale pink mucous membrane, and having a strong white tendon running the whole length on the inside.

Here we have two mice identical even in typical marks, yet one possessing side pouches, the other not. We cannot wonder that *Gapper* created a new genus, to separate them. As bearing on the great question of the day these facts are interesting. The northern mouse collecting stores for the winter having pouches, the more southern one sustaining himself in the open winter, not having them. Does use produce the organ? Or, originally distinct was the organ created before the use. Truth gains and error loses in boldly stating facts though they may be adverse to one's own speculations, and in this spirit have I placed them here on record.

We come next to the voles, or short-tailed mice, certainly more arctic in their rougher coats, concealed ears and short tails:—

Gapper's Mouse.

Arvicola. Gapperi, (Vigors, Baird, Dekay.)
Arvicola. Dekayi, (Audubon, Bachman.)

From a specimen before me in the flesh, given me by J. M. Jones, Esq., February 2nd, 1862:—

Extreme length	5	inches.
Length of head	$1\frac{1}{4}$	inch.

Colour rufus chestnut on the head and back toning down to yellowish brown on the sides, which insensibly fades to the greyish yellow ash of the lower parts. The nose is more pointed, the feet and legs more graceful than the meadow mouse. The tail dusky chestnut above, light ash below. The ears large, chestnut colour, with a very large antitragus. The ear is densely covered, inside and out, with hair, but projects beyond the head. These voles, though not known in the neighbouring States, are not uncommon here, but not so numerous as the meadow mouse. I know nothing of their habits; as this specimen was taken in January they probably do not hybernate.

Bank Mouse.

Arvicola riparia. (Ord, Baird, Audubon, Bachman.)

This vole varies much in size from many specimens before me, the largest measures :—

Extreme length..... ....$6\frac{2}{8}$ inches.
Length of tail.. ....$1\frac{6}{8}$ inch.

The smallest, evidently a young one, though taken on June 4th, and large for the time of year :—

Extreme length...$3\frac{8}{10}$ inches.
Length of tail ....$1\frac{2}{10}$ inch.

There are many specimens intermediate. The prevailing colour is dark brown, with a scarcely perceptible reddish mark as seen in certain lights; the sides have a yellowish wash, and the belly and beneath a plumbeous wash over the prevailing brown. The tail and feet are dusky; the head is robust, though the nose is pointed; the ears well concealed by the numerous longish hairs covering the head and back. The hind legs are far back in running, and the eyes small, but prominent.

These voles are numerous in the Province, colonies of them often inhabiting small islands on the sea coast, where they become very abundant, perhaps from being sheltered from their enemies, the weasel and mink.

With this vole ends the Nova Scotian mice, at least, of my identifying. Of their habits I have had but little observation. Though not personally seeing it, I had the account of the hybernation of *Jaculus Hudsonius*, from one of highest intelligence, who dug one of those curious balls from the ground with its torpid inhabitants. From obtaining *A. Gapperi* in mid winter, as well as *A. leucopus* with a supply of seeds, I infer they do not hybernate. On the other hand, *A. riparia* burrows in the ground though he does not nest there, and entirely disappears in winter. After the grass fields are cut numerous little paths are seen in the short stubble. The waving grass, all the summer long, had made them delightful covered ways for him to travel in, but the hawk and the day-owl pursue him through his unprotected galleries.

In the year 1825, the Province was visited by a plague of mice with white bellies, which, in the rural parts, destroyed everything before them of grain and fruit, whether from excessive reproduction, or an instinct of migration, one knows not. Dr. Baird, in noticing a similar occurrence, on the northern shore of Lake Erie, attributes it rather to the *myoides* than the *leucopas*. An intelligent friend informed me that, disturbing a female mouse in the fields one day, she made off with prodigious leaps with her family hanging to her back, most probably they were attached to her mammæ, as the young of the opossum do, thus showing some slight analogy to that isolated animal. He could not determine the species, which must have been the white bellied or the jumping mouse.

Art. II. Monograph of Ranunculaceæ of the Dominion of Canada and adjacent parts of British America. By George Lawson, Ph. D., LL. D., *Professor of Chemistry and Mineralogy, Dalhousie College and University, Halifax, N. S.*

(*Read December 18th*, 1869.)

Synopsis of Genera.

Tribe I. CLEMATIDEÆ.—Fruit consists of numerous separate carpels, which are single seeded and indehiscent, (Achenes), with long feathery awns. Sepals coloured like petals, valvate or induplicate in æstivation, not caducous. Petals absent, or represented by stamen-like bodies. Mostly tall climbers, with weak woody stems and opposite compound (or simple) leaves, whose petioles (in our species) are twisted-clasping like tendrils.

Genus 1. Clematis, Linn.—Calyx of 4 or 5 large petaloid sepals. Petals absent in some species, in others represented by stamen-like processes graduated centripetally into stamens.

Tribe II. ANEMONEÆ.—Fruit consists of separate carpels, which are single-seeded and indehiscent, (Achenes), in some species with, in others without, long feathery awns. Sepals green, or, more usually, coloured like petals, (frequently large), imbricate in æstivation, not caducous. Petals absent or represented by stamen-like bodies. Herbs with radical leaves and verticillate involucres or alternate cauline leaves.

2. Pulsatilla, Tourn.—Calyx of about 5 or 6 very large petaloid sepals. Petals absent, or a few imperfect processes. Carpels numerous, with long feathery awns. The fruit thus being composed of a large, loose, soft brush of plume-tailed achenes. Flower, solitary, hermaphrodite, leaves usually much divided, involucre large, and similar to the leaves, at first close to the flower; plants with long silky hairs.

3. Anemone, Linn.—Calyx of from 4 to 9 large petaloid sepals. Petals absent. Carpels several or numerous in a compact head, glabrous or pubescent or matted with wool. Receptacle often enlarged, hemispherical or conical. Flower solitary, or several on the same peduncle, hermaphrodite. Leaves ternately divided or lobed, often hairy.

4. Syndesmon, Hoffm.—Calyx of about 7 large petaloid sepals. Petals absent. Corpals ribbed, several awnless. Flowers, several together, hermaphrodite. Stem leaves verticillate, forming an involucre.

5. Thalictrum, Tourn.—Calyx of 4 or 5 small sepals, greenish, or rarely petaloid. Petals absent. Carpels few, usually with prominent ribs lengthways, awnless and usually glabrous. Flowers often diœcious polygamons. Leaves much divided decompoundly into numerous short-lobed leaflets, glaucous, glabrous, or with only very minute pubescence, never with long or silky hairs.

Tribe III. RANUNCULEÆ.—Fruit consists of numerous (or few) separate carpels, which are single-seeded or indehiscent (Achenes) without awns. Sepals small, green or greenish, imbricate in æstivation, not caducous. Petals usually large and coloured, with a gland near the base of each on its inner surface. Herbs with alternate or only radical leaves.

6. Ranunculus. Linn.—Calyx of 5 (rarely 3) green sepals, without spurs. Petals large, glossy, usually yellow, white in some species. Stamens numerous. Carpels several or many, in roundish or oblong heads, on the slightly enlarged receptacle.

7. Moysurus, Dill.—Calyx of 5 sepals, each with a spur at the base. Petals small, with a filiform tubular claw. Stamens 5. Carpels very numerous, the receptacle elongated (in fruit) into a long filiform stalk, like a spike.

TRIBE IV. HELLEBOREÆ.—Fruit consists of several separate carpels, which are many-seeded, dehiscent and pod-like, (Follicles.) Sepals coloured like petals, imbricate in æstivation, deciduous, (in our genera), but not caducous. Petals hollowed out, or spurred, or reduced to stamen-like processes, or altogether absent. Herbs with alternate leaves.

8. CALTHA, Linn.—Flower regular. Calyx of 5 petaloid deciduous sepals. Petals absent. Leaves simple.

9. TROLLIUS, Linn.—Flower regular. Calyx of 5 or many petaloid, deciduous sepals. Petals small and numerous. Leaves palmately divided.

10. COPTIS, Salisbury.—Flower regular. Calyx of 5, 6 or 7 petaloid deciduous sepals. Petals 5 or 6, small, cucullate. Leaves ternate.

11. AQUILEGIA, Tourn. — Flower regular. Calyx of 5 petaloid, deciduous sepals. Petals 5, larger than the sepals, each one hollowed out into a trumpet or funnel-shaped spur. Leaves ternately compound.

12. DELPHINIUM, Tourn.—Flower irregular. Calyx of 5 deciduous, petaloid sepals, the upper sepal produced downwards into a spur. Petals 4, sometimes united, the two upper ones produced at the base into appendages or spurs, which are both ensheathed in the spur of the upper sepal. Leaves palmately multifid.

13. ACONITUM, Tourn. — Flower irregular. Calyx of 5 petaloid sepals, the upper sepal hooded, (called the hemlet), petals enclosed, 2 in number, small, with long claws.

TRIBE V. ACTÆEÆ. — Fruit consists of one carpel, ripening into a many-seeded berry, or of several carpels forming a head of single or two-seeded berries, or of several dehiscent many-seeded follicles. Sepals caducous, (falling off as they expand), æstivation imbricate. Petals small or absent. Herbs with alternate leaves and racemose inflorescence, or (in Hydrastis), single-flowered.

14. CIMICIFUGA, Linn.—Calyx of 4 or 5 caducous sepals. Petals or staminoid processes usually about 4, but variable. Fruit

of several carpels, which are many-seeded, dehiscent (Follicles). Leaves bi-or tri-ternate. Inflorescence racemose.

15. ACTÆA, Linn.—Calyx of 4 petaloid caducous sepals. Petals 4. Fruit of a single carpel, forming a many-seeded berry. Leaves bi- or tri-ternate. Inflorescence corymbose, becoming racemose in fruit.

16. HYDRASTIS, Linn.—Calyx of 3 petaloid caducous sepals. Petals absent. Fruit of several carpels, which form a head of single or two-seeded berries. Leaf simple. Inflorescence unifloral.

Descriptions of Species.

CLEMATIS, LINN.

C. VERTICILLARIS, DC.—Stem shrubby, climbing. Leaves opposite, petioles twisted and clasping as tendrils, leaflets 3, stalked, ovate or more or less heart-shaped, acute, usually toothed. Peduncles opposite, each bearing one large flower. Sepals, 4, large, petaloid. Petals developed as stamen-like process, and pass into stamens. Flowers from two to three inches in diameter.

C. verticillaris, DC. Prod., Hook. Fl. B. A., p. 2. Torrey & Gray, Fl. N. A., p. 10.

Atrangene Americana, Sims. Bot. Mag. Pursh. Chapman, Fl. S. U. S., p. 3.

Not common. Montreal and Belœil mountains, Q., and at Jones's Falls, on the Rideau Canal, Ontario, Dr P. W. Maclagan. Mountain side, east from Hamilton, Judge Logie. North limit in Hudson's Bay Territories, lat. 54°., seldom occurs to N. W. of Ontario, Mr Barnston; has been found on the Pacific Coast, T. & G., and as far south as the mountains of North Carolina, Chapman.

Hooker pointed out that this plant differed from the European *C. alpina* in its acute petals, and in the far smaller and never sharply serrated leaves. Regel describes three varieties of *alpina* in Eastern Russia, besides the allied *C. macropetala*, figured in Plantæ Raddeanæ, tab. 1, which has very small leaves, and large narrowly lanceolate acute petals.

C. VIRGINIANA, Linn.—Stem shrubby, climbing. Leaves opposite, Petioles twisting and clasping as tendrils, leaflets 3, stalked, ovate or somewhat cordate, acute, lobed and coarsely toothed. Peduncles opposite, each bearing a large panicle or cluster of *numerous* flowers. Sepals 4, rather large, petaloid. Petals absent. A climber, 10 or 12 feet high, clinging to bushes and small trees for support. Flowers white, fragrant. The plant is very conspicuous in the fall season, as the leafless stems with their numerous clusters of plume-tailed achenes form large feathery wreaths. The leaflets are always prominently toothed, sometimes almost lobed, never entire as they sometimes are in *C. Vitalba* of Europe and constantly in several Indian species.

C. Virginiana, Linn. Michx. Pursh. Hook. Fl. B. A., p. 1. T. & G., Fl. N. A., I., p. 8.

C. cordata, and *holosericea*, Pursh.

Figured in Mrs Miller's "Wild Flowers of Nova Scotia." 3 series, part 5, fl. 14.

Banks of streams and moist spots, edges of swamps, ravines, etc., from the Atlantic coast of Nova Scotia westward through the Provinces of New Brunswick, Quebec and Ontario. Banks along the roadside at the Rifle Range, Bedford, N. S.; frequent in the townships in rear of Kingston, in Frontenac and adjoining counties, as between Kingston and Odessa, Waterloo and Hinchinbrook; also, Toronto, G. L. Windsor, N. S., Professor How. Nicolet and St. John's, Q., and Niagara, Ontario; also, Montreal, 12th August, 1851, Dr Maclagan, sp. Two miles from Prescott, near Ottawa and Prescott railway, rare, in thickets, northward to Chelsea, Mr B. Billings. Belleville, abundant in low grounds, along small streams, Mr Macoun. Red Lake River, September, 1860, Dr Schultz, sp. Provancher cites Pied du Cap Tourmente and Isle Verte, which is the last outpost north eastwardly.

Mr Barnston observes that westwardly this species does not appear to pass the long. of Red River or Lake Winipeg, and is rare to the N. W. of Ontario Province. North limit (west) "in lat. 55°, about the south end of Lake Winipeg," according to Dummond, but the south end of Lake Winipeg is in lat. 51°. "Canada to Georgia and west to the Mississipi," T. & G. Hooker quotes "banks of the Columbia," on the authority of Douglas.

PULSATILLA, Tourn.

P. patens, Linn.—Whole plant covered with long silky hairs when young, losing much of the hairiness as it becomes old. Leaves radical, long petioled, ternately divided into narrow linear segments. Flower solitary, appearing before the leaves, with a sessile involucre like the leaves, which becomes distant from the flower by the elongation of the upper part of the peduncle as the fruit ripens. Sepals large, silky externally. Carpels of the fruit with long feathery tails. Flowers purplish. Petals are represented by a number of small imperfect processes, arising between the sepals and stamens. The involucre and portion of peduncle below it are densely villous, with long silky hairs, upper portion, very short at first but becoming very long in fruit, scarcely villous or nearly glabrous.

Pulsatilla patens b. Wolfgangiana, Trautv. & Meyer, (exc. syn.,) according to Regel.

Clematis hirsutissima, Pursh.
Anemone, Nuttalliana, D. C.
Pulsatilla Nuttalliana, Gray, Man., edition 2.
Anemone Wolfgangiana, Bess.
A. flavescens, Pritzel.
A. patens, *Linn*. T. & G., Fl. N. A., p. 11. Hook, Fl. B. A., p. 4. Nuttall.
A. patens var. Nuttalliana A. Gray, Man., ed. 5,p. 36.

Regel's *var. intermedia*, (*P. patens var. Wolfgangiana*, Trautv.,) is a different plant, confined to the old world.

I am indebted to the late lamented Governor McTavish for specimens from the following localities :—

Fort Simpson, 1853, between Fort Youcon and Lapierres House, west side of Rocky Mountains; McKenzie River, near Fort Simpson, 8th June; Fort Chipewyan, 4th and 16th May, 1861; Fort Simpson, in ft.; Youcon River; on Anderson River, and at Fort Good Hope; Rocky Mountains, Van Express Party, 1854; Athabasca River, 31st July, 1852, in fl. Lake Manitoba, June, 1861, Dr Schultz sps., Nos. 1, 2, in fl. and ft. Found at Fort Reliance by Capt. Back. Occurs in New Mexico. Widely spread through the Russian dominions of Europe and Asia.

A small form from Fort Simpson, Summer of 1853, (McTavish) has the involucre divided into linear, but rather broad segments, very sparingly villous, sepals almost glabrous.

P. patens is a variable plant in Europe and Northern Asia. In the allied *A. Halleri* of Switzerland, the divisions of the leaves and involucre are proportionately much shorter, and the flower larger.

P. vulgaris of Europe has pinnatisect foliage.

P. ALPINA, Linn.—Involucre and radical leaves similar, leaflets or divisions petiolate, divisions rather broad, with sharply acuminate teeth. Varies with flowers white or yellowish, larger or smaller, leaves more or less dissected, etc., hence the elaborate synonymy. Flowers white in *a.*, Gaudin Fl. Helv., and in *var. major;* yellow in *var. sulphurea* of Europe.

Anemone alpina, Linn. D.C. Jacquin. Koch. Pritzel. Hook, Fl. B. A., p. 5. T. & G., p. 11.

A. sulphurea, Linn.
A. aipifolia, Scop.
A. millefoliata, Bart.
A. myrrhidifolia, Vill.
Pulsatilla alpina, Regel.
P. alba Burseriana, Reichenbach.

Eastern declivity of Rocky Mountains, between lat. 52° and 55° north, Hooker. Kotzebue's Sound, Beechey.

Occurs in Europe and the Caucasus.

ANEMONE,* LINN.

§ 1.—Fruit a globose or cylindrical mop-like head, consisting of numerous closely packed tail-less achenes, imbedded, at maturity, in a matted woolly covering.

A. PARVIFLORA, Michaux.—Leaves roundish, tripartite, with cuneate crenately-lobed divisions. Involucre of 2 almost sessile leaves, near the middle of the stem. Flower solitary, large, sepals 5, oval, white or "tinged with blue." Carpels in a globose, compact, woolly head. Plant variable in size, from 2 to 12 inches

**Anemone*, a name employed by Pliny, and now in common use in the English language. In Latin the quantity of the penultimate syllable is long, but in English, although spelt in the same way, the word is accented on the antepenultimate.

high. In a specimen, from the Youcon River, the involucre is close to the base and hid in the radical leaves; the naked flower-stalk, 6 inches long. Hooker, Torrey & Gray, and other botanists give the number of sepals as 6; they are probably variable. In all my specimens, 16 in number, in which they can be counted, the number is 5, except in one monstrous flower from York Factory, which has 9 ligulate sepals.

A. parviflora, Michaux, Fl. Hook. Fl. B. A., p. 5. T. & G. Fl. N. A., p. 12.

A. caneifolia, Juss. Pursh.

A. borealis, Richardson.

Anticosti, Pursh, and found there, S. W. point, by A. E. Verrill, 23rd July, 1861. Gaspe, found in fl., at mouth of Lady's-step Brook, June 23, 1862, and plentiful up the river, Dr J. Bell. Labrador, Pursh. Labrador, T. & G. The plant is not so rare in the north west, judging from specimens received from Governor McTavish, which are as follows:—

Between Severn and Trout Lake, June; McKenzie's River, 29th May, 1852; between Anderson River and Fort Good Hope; Fort Simpson, Summer of 1853; west of Rocky Mountains, between Lapierres House and Fort Youcon; Athabasca River, 31st July, 1852; Youcon River; York Factory.

A. MULTIFIDA, Poiret.—Leaves ternately divided into cuneiform segments, cleft into linear lobes. Flower arising from a primary involucre, which consists of 2 or 3 short-stalked leaves, with 1 or 2 flowers from secondary involucels. Sepals from 5 to 8, oval-obtuse, half an inch long, red, yellow, or white. Carpels in a spherical or oval, very woolly, head. Plant from 6 to 12 inches high.

A. multifida, Poiret. DeLess. DC. Prod. Hook. Fl. B. A., I, p. 7. T. &. G. Fl. N. A., I, p. 13.

A. Hudsoniana, Richardson.

A. globosa, Nutt.

Gulf of St. Lawrence, Mr Goldie. On gravelly banks and river shingles, Dartmouth River, Gaspé, June 30, 1862, Dr. John Bell. Fort Garry, July, 1861, Dr Schultz, sp., No. 188. The following are from Governor McTavish:—

Fort Simpson, June, 1860; Nipigon, 1852; Slave Lake, 25th June; Youcon River, adjoining Russian Territory, near Arctic Circle; Slave Lake, June, 1860; McKenzie River, above Fort Simpson, 20th June. The last mentioned specimen is a luxuriant form, referable, no doubt, to b. *Hudsoniana*, which is apparently not a permanent variety.

This species has been found at Watertown, in New York State, and on the south shore of Lake Superior. Douglas collected it near the sources of the Columbia, on the west side of the Rocky Mountains. It likewise grows at Conception, in Chili, on the Chilian Andes, and at the Straits of Magellan.

A. VIRGINIANA, Linn.—Leaves ternately divided into acuminate 3-cleft incisely serrated segments or leaflets. Peduncles several, very long, all arising from an involucre of 2 or 3 petioled, ternately divided leaves, the primary or terminal peduncle naked, the secondary ones with 2-leaved involucels, whence arise other lateral peduncles, giving the plant a branched character. Sepals 5, greenish or white. Carpels in an *oval* or *oblong* head, soft with white or tawny wool. Plant 2 or 3 feet high, hairy. The large heads of carpels and stalked leaves of the involucre distinguish this species from *A. dichotoma*.

A. Virginiana, Linn. Sp. Pl. Michaux. Pursh. Hook. DC. T. & G.

Falls of Niagara, September, 1858; also Kingston, 9th August, 1861; on the Humber, near Toronto, 4th June, 1862, G. L. Common, on plains, at Castleton; rare around Belleville, Mr Macoun. Montreal, St. Catherine's and Malden, Dr P. W. Maclagan. Dartmouth River, Gaspé, July 5, 1862, Dr Bell. Carrol's Point, East Flamboro, July, 1859, Judge Logie. Rocky woodlands, near Brockville; also Prescott, northward to Ottawa, rather rare, Mr B. Billings. Between Snake Hill River and Pembina, August, 1860, Dr Schultz, sp. St. Joachim, Provancher. Mr Barnston speaks of this species as, in the North-west, rarer than *A. dichotoma*, and scarcely reaching the Rocky Mountains. Richardson observes: "spreading more widely in Canada than to the northward."

A. CYLINDRICA, A. Gray.—Leaves ternately divided into cuneate segments, cut and toothed. Peduncles several, very long and naked above, all arising from an involucre of stalked ternately divided leaves. Sepals 5, obtuse, greenish white. Carpels in a long *cylindrical* head. Plant 1 or 2 feet high, shorter, more silky in foliage than the preceding, with more slender, wiry stems, and more finely divided leaves, the inflorescence less branched, with fewer involucels. Prof. Gray, the author of this species, observes that it often flowers after the manner of a *A. Virginiana*, developing involucels and secondary peduncles, and that the leaves of the involucre are twice or thrice as many as the flower stalks.

Anemone cylindrica, A. Gray. T. & G. Fl. N. A., I, p. 13.

Near Belleville, also Mr Duff's farm, Kingston, August 8, 1861; Pittsburg, September 6, 1861; Delta, 1st July, 1862; also Kingston Mills; all in the Province of Ontario, G. L. Trail to Red River, 1860, and between Snake Hill and Pembina, 1862, Dr Schultz. Belleville, common on sandy hills, Mr Macoun.

§ 2.—Fruit of comparatively few carpels, and these without either awns or wool, their surface pubescent or glabrous.

A. DICHOTOMA, Linn.—Leaves deeply cleft or divided into from 5 to 7 leaflets, which are cuneate, incised toothed. Flowers several, primary peduncle with a general involucre of three sessile leaves, the lateral stalks with two-leaved involucels, &c. Flower 1½ inch broad, sepals obovate, white. Carpels in a hemispherical head, flat, orbicular, hairy. A handsome free-growing plant.

A. dichotoma, Linn. Mant., Syst. Nat., &c., DC. Prod. Turcz. Maximowicz. Regel, in Radde's Reisen, I, p. 17.

A. Pennsylvanica, Linn. Hook. Fl. B. A., I p. 8, t. 3 b. T. & G., Fl. N. A., p. 14. Ledebour. Trautv. & Meyer. Regel & Tiling. A. Gray, Gen. Ill., I, t. 4.

Portsmouth and elsewhere about Kingston, June 4, 1859; Frankville, Kitley, 5th July, 1862; near Toronto, 2nd June, 1862; Hardwood Creek, rear of Kingston, 1861, G. L.; Carrol's Point, Hamilton, 7th July, 1859, Judge Logie. Prescott, Ottawa, &c., common over the country, Mr B. Billings, Jr. Lake Superior, Prof. Bell. Chippawa and Malden, Ontario, Dr Maclagan. Belleville, common amongst rocks along rivers, Mr Macoun. Gaspe, Banks of Dartmouth River, June 17, July 5, Dr Bell. Anticosti, July 18, 1861, Mr Verrill. From the North-west I have received specimens, as follows, viz. From Governor McTavish:—

McKenzie River, above Fort Simpson, 22nd June; Saskatchewan, 19th July; Lake Nipigon, 1853, (sepals sickly;) McKenzie River, between Fort Simpson and Slave Lake, 21st June, 1853; Lake Superior. Dr Schultz's specimens from: Fort Garry, July and August, 1860; between Wild Rice River and Red Lake River, September, 1860; Assiniboine River, July, 1861, sp. No. 62; Lake Winipeg and Slave Lake, Capt. Back. Provancher seems to find the plant rather rare in Quebec Province.

Linnæus described the two species, *A. dichotoma*, European, and *A. Pennsylvanica*, for which latter the only habitat given was "Canada." DeCandolle pointed out that the American *Pennsylvanica* was similar to the European *dichotoma*, but more slender. Hooker found Dahurian specimens to "entirely accord with the American ones," but, in Fl. Bor. Am., retained the name *Pennsylvanica*. American botanists have followed the example, but European botanists use the name *dichotoma*, which is certainly preferable, especially as the other suggests erroneous ideas of the plant's distribution. In the States it ranges only from "West New England to Illinois, and north westward," (Gray,) whilst in British America it is widely spread, extending from the north easterly parts of the Atlantic coast west to the Pacific, and northwards nearly or quite to the Arctic Ocean. Mr Barnston indicates its range thus: Throughout the extent of the British Territory eastward of the Rocky Mountains, and even westward though less plentifully.

A. NEMOROSA, Linn.—Radical leaf solitary, arising from a short, slender, horizontal rhizome, and compound of three broad, cuneately-lobed or slightly pinnatifid incisely-toothed leaflets. Flower solitary, on a stem which is bare below but with an involucre half way up of three-stalked leaves, divided like the root leaves, the leaflets incisely toothed, the lateral ones with large basal lobes (more usually divided into separate leaflets (compound) in the English, Scotch and German specimens, but only deeply pinnatifid in our American plant), terminal leaflets of involucral leaf slightly stalked, all the lobes acuminate. Sepals 5 or 6, elliptical, glabrous on both sides, (bright white, sometimes tinged with pink or purple). Carpels few, oblong, keeled, pubescent, with hooked beaks as long as the body of the carpel. Plant sparingly hairy. Wood Anemone. Anemone or Wind Flower of the English poets.

A. nemorosa, Linn. Michaux. Pursh. Hook., Fl. B. A., I, p. 7. T. & G. Fl. N. A., I, p. 12.

A. lancifolia. Pursh.

In our plant the upper part of the petiole is more hairy than in European specimens, which are mostly nearly glabrous.

Toronto. Bass River, Kent, N. B., Rev. J. Fowler, sp. Common, Port St. Francis, Q., Niagara and Malden, Ontario, Dr P. W. Maclagan. Barlow's Woods, east from Belleville, Ontario, rare, Mr Macoun. Gros Cap, June, 15, Prof. Bell. Common at the Saguenay, Provancher. Richardson found this plant westward to the south end of Lake Winipeg, not seen N. of lat. 53°. Mr. Barnston found it common to the Westward of Lake Superior, along the frontier line of the United States, in rich alluvial soils. An unusually hairy form was found by Capt. Back, at Lake of the Woods. In Western Europe this species is extremely common, and Regel has it from various collectors in Kamtschatka, &c.

This species varies much in the division of the foliage and other characters. The following comprise our principal forms:

a. typica,—leaves trifoliate, terminal leaflet shortly petiolulate, rhomboidally lanceolate, incisely lobed and toothed in the upper half, lateral leaflets nearly sessile, very deeply divided into two lobes, the lateral lobe oblique, both incisely toothed in the upper part.

b. glabriuscula,—involucral leaves trifoliate, the leaflets sessile, incisely toothed, not divided nor lobed. Hudson's Bay Territories, Governor McTavish, sp. This may be regarded as a diminutive northern form.

c. nitida,—compact, hairy, involucral leaves either of 5 closely sessile rhomboidal leaflets, or of three such leaflets with the lateral ones very deeply lobed, the lobes acute, not acuminate nor spinose, sepals 5, broadly oval-oblong. Bleeker's Woods, near Belleville, May 8, 1861, Mr J. Macoun.

d. quinquefolia,—radical and involucral leaves of 5 distinct leaflets. (*A. quinquefolia*, Linn.) Oaklands, near Hamilton, May 31, 1859, Judge Logie.

A. Richardsonii, Hooker.—Plant with long trailing runners rooting and giving off single trifidly cut petiolate leaves; peduncles naked below, with an involucre at the middle of three slightly cut leaflets; whole plant more or less pubescent.

A. Richardsonii, Hooker, in Franklin's 1st Journ. Flora Boreali-Americana, p. 6, tab. IV, a.

A. Richardsoniana, T. & G. Fl. N. A., I, p. 13.

Churchill, 3rd July, 1853, and York Factory, Governor McTavish, sp. Pethemich Island, Great Slave Lake, 27th June, 1855, Capt. Rae, sp. Found by Richardson on the Rocky Mountains, from lat 55° to 68° N., in wet mossy ground. Capt. Rae's specimens are smoothish; and there is an old pencil memorandum identifying them with "a form gathered by Drummond in 1843, Chippewa," the specimens of which I had probably seen in the Edinburgh Herbarium.

A. Hepatica, Linn.—Plant acaulescent, leaves numerous, all radical, from a tufted rhizome, long-stalked, of 3 rounded obtuse lobes (slightly overlapping), which are undivided with entire margins, or occasionally with the lateral lobes more or less divided. Flowers many, from the same root, on separate stalks, involucre close to the flower, (calyx like.) Sepals white, blue, purple or rose-coloured, variable in size. Leaves, petioles and flower stalks, when young, covered with silky pubescence, which passes off as the foliage matures, the surfaces becoming glabrous. Achenes about 12 in number, hairy, collapsing into furrows.

Anemone Hepatica, Linn. Michaux.

H. triloba d. foliorum lobis obtusis, Hook., Fl. B. A., I, p. 9.

Hepatica tribola, Chaix.

H. tribola a. obtusa. T. & G., F. N. A., I, p. 15.

H. Americana, Ker. DC. Nutt.

Common in rich woods in central Ontario.

Longpoint, on Gananoque River, May, 1861, leaves partially five-lobed, and infested with a Uredo; very abundant on wooded banks, near the Grand Trunk Line, between Kingston Depot and Kingston Mills, G. L. Belleville, abundant in rich woods, Mr Macoun. Very abundant in Caledon, June, 1862, Rev. C. I. Cameron. Mountain side, west of Hamilton, April 6, 1860, Judge Logie. Rocky woodlands, west of Brockville, not rare; Ottawa, Lot O, rare, Mr B. Billings. Windsor, N. S., Prof. How, rare. Petit Cap St. Joachim, Provancher. River Winipeg, Capt. Back. Not within the Hudson Bay Co.'s Territories, except in the range of the Rocky Mountains, Barnston, where it was found by Drummond north to 55°.

In the European plant the sepals appear to be usually larger in proportion to the leaflets of the involucre than in our plant. *A. Hepatica* occurs in shady woods in Florida, but *acutiloba* is not known in the Southern States.

A. ACUTILOBA, DC.—Resembles the preceding, except that the leaves are very symmetrical in shape, the lobes or divisions elongated tapering, being gradually narrowed from below the middle to an acute point. Those botanists who distinguish between species and sub-species would regard this as a sub-species. The leaves are occasionally five-lobed in both plants.

Anemone triloba b. acuta, Bigelow. Pursh.

Hepatica acutiloba, DC.

H. triloba, b. foliorum segmentis acutis, Hook. Fl. B. A., I, p. 9.

H. triloba b. acuta, T. & G. Fl. N. A., I, p. 15.

Longpoint, Gananoque River, May 7, 1861, abundant; near Kingston Railway Depot, May 2, 1868; two miles west from Kingston Mills, 24th May, 1859, G. L. Camden, Dr Dupuis, sp. Prescott, Ottawa, &c., common in woods, Mr B. Billings, Jr. Very abundant in dry woods, Belleville, Mr Macoun. Artemisia, May 12, Rev. C. I. Cameron, sp.

The *Hepatica* group of *Anemone*, (*A. Hepatica* and *A. acutiloba*,) so unlike many of the others, is yet connected with the other species of the genus, such as *A. nemorosa*, through *H. angulosa*, figured in "Gartenflora," t. 419, which has an approximate calyx-like involucre and otherwise resembles *A. apennina*. And then, on another side, the genus *Thalictrum* is linked to *Anemone* by *Syndesmon*.

Excluded Species.

A. NARCISSIFLORA, Linn.—Leaves palmately divided into cuneate segments, incisely cleft, lobes linear, acute. Petiole bearing several or only one short-stalked flower in the involucre, which is sessile, the leaflets 3 to 5-cleft. The American form is clothed with long silky hairs.

A. narcissiflora, Linn. Ledebour. Pursh. Regel. Hook. T. &. G.

This Pacific plant is not known to exist within the limits of British America. All botanists believe that Pursh attributed the plant to "Canada" by mistake, It was strictly confined, in its known range on the American Continent, to the coast of Russian America, until recently found by Parry, Hall and Harbour in the alpine region of the Rocky Mountains, between lat. 39° and 41°. It has a wide range on the mountains of Europe and Asia; Regel notices it in Dahuria, Prussian Mongolia, East Siberia and Kamtschatka, flowering in June. My own specimens are chiefly from Southern Europe.

This is a characteristic and elegant species, not likely to be confounded with any other; it is, nevertheless, variable, and Regel enumerates five distinct named varieties besides the typical plant. Much prized, but rare, in cultivation.

SYNDESMON, Hoffm.

S. thalictroides.—Root of few fleshy tubers; radical leaves, few long-stalked ternately compound with stalked leaflets, cauline leaves similar, forming an involucre. Plant 5 or 6 inches high, with habit and foliage of *Isopyrum*, flowers of *Anemone* and fruit of *Thalictrum*, DC.

Anemone thalictroides, Linn. Bigelow. Barton. Bot. Mag., Pursh.

Thalictrum anemonoides, Michaux. Hook. Gr. Man., ed. 5, p. 38. T. & G., I, p. 39. DC.

St. David's, Niagara District, Dr P. W. Maclagan. Oaklands, Hamilton, Ontario, 31st May, 1859, Judge Logie.

THALICTRUM, DC.

T. Cornuti, Linn.—Root fibrous. Stem strong and tall, prominently furrowed, (3 to 4 feet high). Radical leaves long-stalked, very large, and, like the *sessile* cauline leaves, ternately decompound; leaflets large, thick, glaucous or downy beneath, varying from broadly obovate to narrowly elliptical in outline, ternately divided into rather large, acute lobes. Flowers numerous, in large, showy panicles, diœcious or polygamous; sepals white, anthers crowded erect on short stoutish filaments; stigmas very long, flattened.

T. Cornuti, Linn. Pursh. T. & G. Hook, Fl. Boreali-Americana, I, p. 3, table 2, (an excellent figure.)

T. rugosum, Pursh. DC. *T. rugosum*, Aiton, is referred doubtfully by Gray to *T. purpurascens.*

T. Canadense, Cornuti, Tournefort, &c.

T. corynellum, DC. Richardson.

Wet meadows and margins of streams, uot uncommon throughout the Provinces of Ontario, Quebec, Nova Scotia, New Brunswick. Kingston, Ont., Hardwood Creek, and surrounding country, abundant, 10th July, 1861; Halifax County, not rare, G. L. Frequent in Quebec Province, Mr Barnston. Chippewa and Malden, Ont., Dr. Maclagan. Gaspe, moist places along the Dartmouth River, Dr Bell. Windsor, N. S., Prof. How. Prescott and Ottawa, common, Mr Billings. Lake Superior, Professor Bell. Belleville, common on the borders of streams, Mr Macoun. Anticosti, 1861, Mr Verrill. Newfoundland, Bonne Bay and Point Rich, July, August, 1861, Mr J. Richardson, sp. Between Wild Rice River and Red Lake River, Sept., 1860, Dr Schultz, sp. Assinaboine River, July, 1861, Dr Schultz, sp., Nos. 40, 58. This species appears to extend to the Pacific, but its range in the west has not been traced.

T. purpurascens, Linn., has been recently investigated by Professor A. Gray, who describes it in the new edition of his Manual as nearly related to *T. Cornuti*, not to *T. dioicum* as previously believed. The *T. purpurascens*, reported to exist in Quebec Province, is merely a common form of *T. dioicum*. But the true *T. purpurascens*, although as yet known only as a rather southern plant, should be looked for throughout the Dominion; it resembles *Cornnti*, having sessile stem-leaves, but the flowers are greenish (not white), the anthers are drooping (not erect), and it grows in dry (not wet) situations.

T. DIOICUM, Linn.—Root of strong, thick fibres, sometimes almost tuberous; stem 12 or 14 inches, varying to 2 feet or more in height, with long-stalked ternately compound leaves, composed of rounded thin broad-lobed leaflets. Flowers diœcious or polygamous, in panicles. Sepals greenish, with yellow or dull purple, long, slender, pendent anthers. Carpels deeply furrowed, several usually abortive.

T. dioicum, Linn. Pursh. Hooker. Torrey & Gray.

Dry woods and banks, common in central Ontario, as woods about Trenton, June, 1862; around Gananoque Lake, Birch Island, &c., May, 1861; near Kingston Mills, and woods near Kingston Depot, 2nd May, 1860, G. L. Mountain side, Hamilton, 12th May, 1860, Judge Logie. Prescott and Ottawa, common, Mr Billings. Ellis's Bay, Anticosti, July 4, Mr J. Richardson, (also found in Anticosti by Mr Verrill.) Niagara Falls and Malden, Dr Maclagan. Belleville, abundant in rich woods, Mr Macoun. Montreal Mountain, Mr James Adie, sp, McKenzie River, above Fort Simpson, 22nd June, 1853; Trout Lake, June; between Severn and Trout Lake, June, Governor McTavish, sp. Near the Big Lake of Harrington, Co. Argenteul, July, 1861, Dr. John Bell, sp. Assinaboine, July, 1861, Dr Schultz, sp., No. 71.

T. CLAVATUM, DC.—Plant tall and slender, with shortly petioled ternately compound leaves; flowers hermaphrodite; carpels pale, thin and pod-like, stipitate, with embossed veins, but no furrows.

T. clavatum, DC. Hooker, Fl. B. A., I, p. 2, T. & G., Fl. N. A., I, p. 37. Gray's Manual, 5 ed., p. 39.

York Factory, Governor McTavish, a large number of specimens collected during several seasons.

When the Floras of Hooker and Torrey & Gray were published, only one certain locality was known for this species, Portage La Loche, 57° N. It has since been found on the mountains of S. Virginia and Carolina.

T. ALPINUM, Linn.—Root fibrous; stem simple, smooth, 3 to 6 inches high; leaves nearly all radical, long-stalked, biternate; flowers hermaphrodite, in a simple raceme; carpels shortly-stalked, tipped with the hooked style; plant only a few inches high.

T. alpinum, Linn., Sp. Pl. T. & G. Fl. N. A., I, p. 39.

First recorded as Canadian on the authority of Kalm; subsequently found on the Island of Anticosti, in the Gulf of St. Lawrence, by Pursh; not noticed by Hooker in Flora Boreali-Americana; again collected on Anticosti by Verrill, rare and not in flower, 1861; Newfoundland, Herb. Banks; Greenland, Hornemann. Its stronghold is in northern Europe, where it occurs chiefly on the mountains, descending to the sea level as it approaches the Arctic Circle, and extending eastward through East Siberia. Found recently on the Rocky Mountains by Dr Parry's party. It usually occurs in small quantities in isolated localities, and its known range is likely to be extended by careful observation.

RANUNCULUS, Linn.

§ 1.—Carpels smooth, both the radical and cauline leaves compound or deeply divided ternately.

R. fascicularis, Muhlenberg.—Root composed of a fascicle of thick fleshy fibres or slender fusiform tubers; stem short; leaves ternately divided in a pinnatifid manner, more or less compound, pubescent with appressed silky hairs; petals twice as long as the sepals; carpels very short, usually margined, with slender terminal beaks.

R. fascicularis, Muhlenberg, Cat. DC. Bigelow. Hook., Fl. B. A., I, p. 20, t. 8. T. & G. Fl. N. A., I, p. 23.

Some of my specimens are precisely like Hooker's figure in Fl. B. A., but the plant varies with much broader and more irregular leaf-lobes.

Near Toronto, 2nd June, 1862, and near Trenton, Ontario, 6th June, 1862; also on hilly ground in the Vale of Trent, above the village, G. L., sp. Trenton Depot; on commons east from Belleville, Mr Macoun, sp. Kingston Mills, Chippewa and Malden, Dr Maclagan. Reported from Somerset by Provancher.

Hooker gives its range as from Canada West to the south end of Lake Winipeg.

R. repens, Linn.—Root of strong fibres; stem more or less erect, with prostrate creeping scions from the base; leaf composed of three stalked leaflets, which are three-lobed, the lobes trifid and cut; flowers large on furrowed peduncles; sepals erect-patent, pubescent, receptacle hairy; plant rough with long hairs or nearly glabrous. The indigenous plant is but slightly hairy, with few runners, and grows in wet places.

R. repens, Linn. Hooker. T. & G.

R. nitidus, Hooker, (according to T. & G.)

In wet soil at the base of a wooded bank, near Toronto, 2nd June, 1862, the indigenous plant, pointed out to me by Professor Hincks, F. L. S., who has observed it there for many years. The introduced form is a common weed in cultivated soils, and although only reported from Quebec, Toronto, St. Joachin, Malden, Kingston and Halifax, will probably be found in every field and garden throughout the Dominion.

"*R. repens b. hispidus.* McKenzie River, Mr Barnston."

R. Pennsylvanicus, Linn.—Stem strong and erect. Leaves of 3 distinct stalked leaflets, which are ovate-acute, ternately cleft and toothed. Whole plant rough with strong spreading bristly hairs. Petals small. Heads of carpels oval-oblong on an elongated receptacle, carpels smooth with short beaks.

R. Pennsylvanicus, Linn. Hook. F. B. A., I, p. 19. T. & G. Fl. N. A., I, p. 22.

R. hispidus, Pursh.

Hinchinbrook, July, 1862; between Kingston and Waterloo, 25th July, 1860, G. L. Nicolet and Chippewa, Dr Maclagan. Belleville, abundant in waste places, Mr Macoun. Prescott district, wastes, common, Mr B. Billings, Jr. St. Joachim, Provancher. Fort Simpson, June, Governor McTavish, sp. Fort Garry, July, 1861, Dr Schultz, sp., No. 126. Lake Winipeg, Back. To lat. 67°, Hook. West to the Pacific, T. & G. Nepean, B. Billings, Jr., sp.

R. bulbosus, Linn.—Root of uniform fibres from the large bulbous base of the stem. Radical leaves composed of 3 stalked leaflets, which are tripartite, the segments trifid and cut. Peduncles furrowed. Sepals reflexed, hairy. Receptacle hairy.

R. bulbosus, Linn. DC. Michaux. Hook. Pursh. T. & G.

An introduced European plant which grows in fields and pastures in a few localities in the Northern States, and is said to grow in

Canada and Newfoundland, but I have not yet seen specimens. Reported as common in Caledon, but probably a mistake.

R. ACRIS, Linn. — Root fibrous. Radical leaves palmately tripartite, segments trifid and deeply cut, uppermost stem leaf tripartite with linear segments. Peduncles round, not furrowed. Sepals erect-patent, pubescent. Receptacle glabrous. The plant is slightly hoary with short pubescence, which gives it a pale hue, while *A. repens* is always, in exposed places, of a dark green.

R. acris, Linn. Pursh. DC. Hook. T. & G.

A European plant, introduced and now common throughout the cultivated parts of Canada, a weed in pastures and by waysides, (much less abundant than *R. repens*, which spreads rapidly with cultivation); not seen in woods remote from settlements. Common in central Ontario, as about Kingston, &c., and also in Nova Scotia, as Halifax county, but not a troublesome weed there as is *R. repens*. Montreal and St. John, Q., Dr P. W. Maclagan. Ellis's Bay, Anticosti, July 15, 1861, Mr Verrill. Gaspé, common in hay fields, 1862, Dr J. Bell. Common about Hamilton, Judge Logie. Prescott district, common, Mr Billings. Windsor, Prof. How. Point Rich, Newfoundland, May 7, 1861, J. Richardson, sp. Belleville, Mr Macoun. Lake Manitoba, July, 1861, Dr Schultz, No. 18. To lat. 58°, Hook.

Animals reject this species, while they greedily eat *R. repens*. I have seen a very hairy form collected near Kingston, 25th July, 1860.

§ 2.—Carpels smooth (except in *R. sceleratus*), radical leaves roundish or undivided, or simply cleft but not to the base.

R. RHOMBOIDEUS, Goldie.—Stem very short, rising to 5 or 6 inches in flower and fruit. Leaves mostly radical, ovate or obovate, more or less rhombic or sagittate, long petioled, toothed, those on the stem nearly sessile, lobed or parted, the upper ones into linear segments. Flowers large. Carpels globose, with very minute beaks, in round heads. Whole plant pale green, with soft hairs.

R. rhomboideus, Goldie in Edin. Phil. Jour. Hook. Fl. B. A., p. 12. T. & G. Fl. N. A., p. 18.

R. ovalis, Hooker. T. & G.

R. brevicaulis, Hooker. T. & G.

R. cardiophyllus, Hook., probably, and of T. & G.

Chiefly confined to the western parts of Ontario. Lake Simcoe, Mr Goldie. Sand hills, on the banks of the Humber, near Toronto, 4th June, 1862, plentiful, G. L. Rocky Mountains (*R. ovalis*), and shores of Lake Huron (*R. brevicaulis)*, Richardson. Sandy plains near Castleton, also at Murray town hall, Mr Macoun. Lake Winipeg, Mr Barnston. The habitat, "near Montreal," given on authority of Dr Holmes by Torrey & Gray, is an outlying station.

R. AURICOMUS, *b.* AFFINIS, R. Br.—Radical leaves long-stalked. pedately divided or lobed, cauline leaves quite sessile, divided to the base into long narrow linear segments. Stem erect (6 or 7 inches high) 2 to 3 flowered, pedicels and calyx hairy.

R. affinis, R. Brown, in Parry's 1st Voy. Richardson. Hook. Fl. B. A., t. 6 A. T. & G. Fl. N. A., p. 18.

Churchill, 3d July, 1853, Governor McTavish, sp. Extends to the Arctic Sea, and from long. 95° to the western declivity of Rocky Mountains. Kotzebue's Sound, Hook. Slave Lake, Back. Lake Winipeg, Barnston. Runs down the Rocky Mountains into New Mexico, as appears from Parry and Fendlen's collections.

Neither this plant, nor the typical *auricomus* (if it be distinct), is known to exist in the Provinces of Ontario, Quebec, New Brunswick or Nova Scotia. A statement to the contrary is founded on a misreading of Fl. B. A.

R. auricomus has been reported from Greenland, and was recorded by Pursh as a native of Pennsylvania, but has not been found by anyone else in the United States. Thlew-ee-choh and Athabasca, Hook. in Back's Journal.

R. ABORTIVUS, Linn.—Radical leaves petiolate, roundish or kidney-shaped, more or less crenate, smooth and shining, those of the stem very shortly stalked or sessile, and divided or parted into oblong, cuneate or broadly linear divisions. Petals shorter than the sepals. Carpels in globose heads, inflated, with small curved beaks. Stem and petioles very slightly hairy, almost glabrous.

R. abortivus, Linn. Pursh. Hook. (in part.) T. & G.

Abundant about Kingston and surrounding country, in pastures and woods; Indian Island, Bay of Quinte, 5th June, 1862; Sloate's Lake, Sydenham, 7th June, 1859; Kingston Mills, 24th

May, 1859, &c., G. L. Portland, July, 1860, Dr Dupuis, sp. Fort Garry, July, 1861, Dr Schultz, sp., No. 180. Nicolet, Montreal, Kingston and Malden, Dr Maclagan. Belleville, abundant in low wet places, Mr Macoun. Common in Caledon, Rev. C. I. Cameron. Roadsides, Hamilton, Judge Logie. Lake Winipeg, Mr Barnston. To lat. 57°, Hook. Lac St. Jean, also St. Joachim, Provancher. Belœil, Dr J. Bell. Bass River, Kent, N. B., Rev. J. Fowler, sp. Prescott district, common, Mr Billings. Osnabruck and Prescott Junction, 20th May, 1859, Rev. E. M. Epstein. Gaspé, Douglastown and north fork of Dartmouth River, June 18, 1862, Dr Bell. Anticosti, June 25, 1861, Mr Verrill. Newfoundland. Hudson's Bay Territories, Governor McTavish, sp.

There are two principal forms:

a. *pratensis*; root of stout fibres, leaves thick with stout petioles, stem short and stout (from 3 to 7 or 8 inches high). In pastures, open fields and waysides.

b. *sylvaticus*; root fibres slender, leaves thinner, with longer petioles, stem elongated and lax (12 to 18 inches high), with fewer radical leaves having longer petioles. In woods.

R. SCELERATUS, Linn.—Root fibrous. Stem thick and hollow, (1 foot high). Leaves somewhat fleshy, smooth and glossy, the radical and lower cauline ones stalked, three lobed or three parted, rounded, the segments blunt, crenate, upper leaves sessile, trifid, the lobes linear, entire or incise dentate. Sepals reflexed. Petals scarcely longer than the sepals. Carpels transversely wrinkled. Juice acrid.

R. sceleratus. Linn. Pursh. DC. Hook. T. & G.

Sides of ditches and wet places. Collins's Bay, Cataraqui Creek, and other bays along the shore of Lake Ontario, G. L. St. Catherines and Malden, Dr Maclagan. Belœil Mountain, Dr John Bell. Ditches around Belleville, common, Mr Macoun. Rainy Lake and Slave Lake, Capt. Back. Lake Winipeg, Mr Barnston. York Factory, Governor McTavish, sp. Common about Hamilton, Judge Logie.

R. RECURVATUS, Poiret.—Leaves long-stalked, cleft into 3 wedge-shaped divisions or lobes, which are again cut and toothed towards the apex. Petals shorter than the sepals. Carpels crowded into a compact round head, with conspicuous slender recurved beaks. The radical leaves are rather less deeply divided than the cauline ones, and their lobes are often rounded. A rather dwarf-growing, rough, hairy plant.

R. recurvatus, Poiret, Encyc. Hook. Fl. B. A., I, p. 20 (partly). T. & G. Fl. N. A., I, p. 22.

Banks of the Humber and near Toronto, 2nd June, 1862; Hardwood Creek, 10th July, 1861; Delta, 2nd July, 1862; Newboro-on-the-Rideau, 23rd July, 1859; near Trenton, 6th June, 1862; Sloate's Lake, Sydenham, Ont., 7th June, 1859, G. L. Sulphur Spring, near Ancaster, July, 1859, Judge Logie. Prescott district, in woods, common, Mr B. Billings, Jr., sp. Nicolet and Chippewa, Ont., Dr Maclagan. Belleville, abundant in low moist woods, Mr Macoun. Common in Caledon, Rev. C. I. Cameron. Pied du Cap Tourmente, Provancher. Bass River, Kent, N. B., Rev. J. Fowler, sp. Labrador.

R. PYGMÆUS, Wahl.—Whole plant glabrous. Radical leaves stalked, cauline ones sessile, both cleft into from 2 to 5 lobes. Flower solitary, sepals glabrous, petals smaller than the sepals. Carpels roundish, with short hooked beaks. Allied to *R. hyperboreus a. nivalis.*

R. pygmæus, Wahl. Fl. Lap. Pursh. Hook. T. & G.

Labrador, Pursh and others. Found along the Arctic coast of America, Spitzbergen, &c.

R. NIVALIS, Linn.—Radical leaves long stalked, cleft palmately but not deeply into about five broad, somewhat ovate, obtuse lobes; cauline leaves palmate, nearly sessile. Flower solitary, sepals covered with matted brown hairs, upper part of peduncle with similar but short hairs, petals longer than sepals. Carpellary beaks nearly straight. A humble plant.

R. nivalis, Linn. Hook. Fl. B A., I, p. 17. T. &. G. Fl. N. A., I, p. 20. Brown. DC. Prod.

R. sulphureus, Solander.

Repulse Bay, Dr Rae, specimen given to me by Governor McTavish.

This is quite a northern species, having been found only on the Arctic shores, Labrador, Greenland, Spitzbergen, Kotzebue's Sound, and on the Rocky Mountains in lat. 55°. Captain Rae's specimens accord very well with the description of Torrey & Gray's var. *b.*, *R. sulphureus* of Solander and of Schlechtendahl.

§ 3.—Carpels smooth, none of the leaves divided.

R. Cymbalaria, Pursh.—Main stem throws off runners, which root and become leafy at the joints, forming new plants. Leaves long-stalked, orbicular, somewhat cordate, crenately notched or almost lobed. Flowers several, on a leafless stalk a few inches high, with one or two distant bracts. Carpels very numerous with short beaks.

R. Cymbalaria, Pursh. Fl. Am. Hook. Fl. B. A., I, p. 11. T. & G. Fl. N. A., I, p. 17.

Musquodoboit River, Nova Scotia, 25th June, 1870, Mr W. H. Lindsay. Gaspé, at the mouth of the Dartmouth River, in situations nearly as low as Gaspé Bay, July 15, leaves sometimes floating, Dr Bell. Windsor, N. S., Prof. How. Anticosti, July 5, 1861, Mr Verrill. Hudson's Bay Country, Gov. McTavish, sp. York Factory; also Slave Lake, 2nd July, Gov. McTavish, sp. Lake Winipeg, Mr Barnston. Fredericton, Dr Robb. New Brunswick, gulf shore, Rev. J. Fowler. Bay of Fundy, Mr Matthew. St. Joachim. Rimouski.

R. Flammula, Linn.—Stem (a foot high) more or less erect from a reclining base, with adventitious roots from the lower joints. Leaves ovate-lanceolate, narrowed at the base into short petioles, usually glabrous. Carpels small, with short beaks.

Margins of creeks, ditches, &c. Localities for this plant have been given in numerous local lists, but they have in so many cases been found to refer to *R. reptans* that I have not been able to trace the distribution of *Flammula.* Found in rich artificial soils, and apparently a derivative of the following species.

R. reptans, Linn.—Plant much smaller, and of a dwarf habit, the stem procumbent, rooting at the joints. Leaves very narrow, linear. Flowers small.

R. reptans, Linn.

R. reptans d. filiformis, T. & G., Fl. N. A., I, p. 16.

Islands in the St. Lawrence River, near Brockville and elsewhere on the northern shores of the upper St. Lawrence and Lake Ontario, G. L. North to lat. 69°., Richardson. Nicolet, Montreal, Wolfe Island, Dr P. W. Maclagan. Dried up ponds near Fort Wellington, Prescott, and Banks of St. Lawrence west from Brockville, Mr Billings. Lake Winipeg and Athabasca River, 31st July, 1862, Governor McTavish, sp. Sparingly amongst sand, east side of River Trent, below Heeley's Falls, Seymour, Mr Macoun. Lake St. Charles, Provancher. Newfoundland, Labrador, T. & G.

This form is well known in northern Europe, and extends to Kamtschatka, but is not very common. Our Canadian plant agrees perfectly with my Scotch specimens (from Loch Leven, Mr Evans,) and Norwegian ones collected by Dr T. Anderson on the Dovrefeldt, 3,500 feet. Specimens from Braemar, Scotland, have narrowly lanceolate leaves, apparently connecting this with *Flammula*. In Canada it appears to be permanently distinct.

R. pusillus, Pursh, is noticed in a Hamilton list, but I have no farther information respecting it.*

§ 4.—Carpels smooth, submersed leaves more or less perfectly dissected into capillary segments, flowers yellow.

R. MULTIFIDUS, Pursh.—Plant wholly or partially submersed, stem rooting at the joints. Leaves orbicular in outline, the lower or submersed ones dissected into numerous very narrow linear segments or veins; the upper or floating leaves flat, rounded, lobed or cleft, but not dissected. Petals large, bright yellow.

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*Since the above was written, I have received the following communication from Judge Logie:—

"HAMILTON, 25th DECR., 1869.

"DEAR SIR:—

"Your letter of the 7th I received a little more than a week ago, and on looking for the plant about which you wish for information, *Ranunculus pusillus*, could not find it. I exhibited my collection at the Provl. Exhibition here in 1868, and made out a list which I sent with the specimens; the list was made from the plants themselves—not from the old list—and checked over from the specimens afterwards. As the name appears in that list I must have had it at that time. Thinking it might have got mixed up with other specimens, I have since looked over my whole collection without being able to find it, and have been obliged to come to the conclusion that it has been lost.

"The year in which I collected it was the first year I had made any collection, and it is probable I may have been mistaken in supposing it to be *R. pusillus*, it may have been *R. Flammula* or *R. alismæfolius*, which seem to be more northern in their habit. If mentioned at all in your monograph you had better mention it as of very doubtful occurrence in Canada."

R. multifidus, Pursh. Fl. Am., II, p. 736.
R. Purshii, Richardson. Hook. Fl. B. A., I, p. 15, t. 7, B.
R. radicans, C. A. Meyer in Led. Fl. Alt. Regel.
R. Gmelini, Fl. Sibirica.
R. delphiniifolius, Torrey.

In ditches and muddy pools. Sloate's Lake, Sydenham, 7th June, 1859; near Yarker, 11th July, 1861; marsh between Forfar and Newboro, 4th July, 1862, G. L. Creek in Glandford, 25th May, 1860, Judge Logie. Conway's Creek, Prescott, Mr B. Billings. Windsor, N. S., Prof. How. To near the Arctic Sea, Hook. Malden, abundant, Dr Maclagan. Very abundant in ponds around Belleville, Mr Macoun. Judge Logie sends specimens from near Milgrove, Hamilton, of a peculiar form with leaves (submersed) much less divided than usual, and flowers half the usual size. At Yarker I gathered a very small hairy form.

This species forms a connecting link between the white-flowered *Batrachian Ranunculi* and the great mass of species with yellow flowers, having the foliage and habit of the former with the flowers of the latter.

§ 5.—Carpels deeply wrinkled across, submersed leaves dissected into capillary segments, flowers white. This section forms, in the opinion of some botanists, a distinct genus, under the name of *Batrachium*, of which there are many reputed species in Europe.

R. AQUATILIS, var.—Plant wholly submersed, with usually long floating stems. Leaves orbicular in outline, but wholly dissected into narrow thread-like segments or veins, the intermediate parenchyma being undeveloped. Pedicels slender and curved. Petals rather small, white with yellow claw, receptacle hispid in fruit. The form described is the common Canadian one, which approaches but is not quite identical with the European *R. trichophyllus*, Godron. None of the forms, so common in Europe, with undissected floating leaves have been found in British America.

In 1861, I gathered a plant in pools by the roadside near Yarker, Ont., which seemed to approach very closely to *R. trichophyllus*. The following descriptive notes were made at the time upon the living plant:—

Ranunculus aquatilis var. trichophyllus? Stem slender and weak, rooting from nearly all the joints; leaves all submersed, formed of capillary segments which are not all in one plane; petals small, narrowly elliptic-ovate, faintly veined, white, with yellow claw and yellow nectary; receptacle small, globose, hispid; carpels inflated on the peripheral side, with recurved (hooked) tips.

Lakes and creeks, growing from a muddy bottom, usually where the water is comparatively shallow and the current slow. Gananoque River and Rideau Canal, G. L. Mr Barnston says it stretches north to 56°, and is less abundant to the westward. Belleville, abundant in ponds in many places, Mr Macoun. Governor McTavish sends several specimens from the Hudson's Bay Co.'s Territories. La Cloche Island, in shoal water, Oct., 31, Prof. Bell. Burlington Beach, near Waterworks, Hamilton, July, 1859, Judge Logie. Conway's Beach, a mile west from Prescott and Railway Bay, common, Mr Billings. Saskatchewan River, Capt. Back. St. Tite, Provancher.

A fragment from Gananoque River is referable to *R. divaricatus*, Schrenk.

Doubtful Species.

R. DIGITATUS. Hooker?—("Root a fascicle of tubers?"); leaves pedately divided into broad linear lobes; petals 7 to 9, yellow. Plant only a few inches high. Specimen imperfect.

Rocky Mountains, Van Express Party, spring of 1854, Governor McTavish. This is a fragment, consisting of the upper part of the stem with leaves and one flower, petals 7, agreeing very well in general aspect with *R. digitatus*, figured by Sir William Hooker in "Kew Garden Miscellany," vol. iii, pl. 4.

Excluded Species.

R. CAROLINIANA, DC.—(*R. nitidus*, Hook. Fl. B. A.,) is a southern plant, confined to the pine barrens of Middle Florida and South Carolina, where it is rare. Its record as Canadian is no doubt a mistake.

MYOSURUS, LINN.

M. MINIMUS, Linn.—Leaves all radical, linear. Stem simple, single flowered, 3 or 4 inches high. The receptacle of the flower elongates by growth as the carpels ripen, into a long slender stalk like a spike. *Mouse-tail.*

Myosurus minimus, Linn. T. & G., Fl. N. A., I, p. 25.

Belleville, rare, Mr Macoun.

Found in Illinois, Kentucky, Georgia, Louisiana, Arkansas, Oregon, and in Europe.

Dr Parry, in his paper on the North American Desert Flora between 32° and 42° North Latitude, (read at Meeting of British Association at Liverpool, 1870, and published in the "Journal of Botany," for Nov., 1860, vol. iii, p. 343), notices *Myosurus minimus* as the only Ranunculaceous plant of these desert tracts. The annual desert plants, he observes, require for their continued preservation a safe deposit for their usually minute seeds during the prolonged dry season, a condition which is in great measure supplied by the porous, sandy and gravelly soil into which they fall and are safely buried, not only out of the reach of climatic influences, but also safe from the destruction of animals. In accordance with this view we find *Myosurus minimus* occurring, and to a very limited extent, in the arid sand drift of the Belleville district, where I believe it to be indigenous. It should be looked for farther west, especially on the dry sand hills around the western extremity of Lake Ontario, and on similar soil westward toward the Manitoba Country.

CALTHA.

C. PALUSTRIS, Linn.—Stem thick, hollow, leaves rounded, reniform or cordate, lobes rounded, margin crenately notched or nearly entire.

C. palustris, Linn. Michaux. Pursh. T. & G., I, p. 26.

C. integerrima, Pursh.

In ditches by the roadside, two miles west from Kingston Mills, 24th May, 1859, specimens with entire and strongly saw-edged leaves on the same plant; in several places along the course of the Rideau Canal, G. L. Amherstburg, Dr Kemp. Osnabruck and Prescott Junction, 20th May, 1859, Rev. E. M. Epstein, sp. Bass River, Kent, N. B., Rev. J. Fowler. Swamps, Addington County, June, 1860, Dr Dupuis, sp. York Factory, Governor McTavish, sp. Opposite Gros Cap, June 15, Prof. Bell. Hamilton, in wet ground east from the city, near Mr Aikman's house, 25th April, 1860, Judge Logie. Prescott district, common, Mr

Billings. Mingan and Anticosti, 1861, Mr Verrill. Gaspé, mouth of Douglastown River, &c., June 3rd and 9th, 1862, Dr Bell. Newfoundland, L'Anse du Loup, Str. of Belleisle, July, 1861, Mr J. Richardson.

C. NATANS, Pallas.—"Stem procumbent, floating; leaves reniform-cordate, crenate, with the lobes somewhat approximated, obscurely crenate towards the base, toothed towards the summit; sepals oval; carpels with a straight beak."—T. & G. Flowers white, Hook.

C. natans, DC. Prod. Hook. Fl. B. A., I, p. 22. Ledebour. T. & G. Fl. N. A., p. 27.

Creeping on the surface of deep sphagnous swamps, in the woody central districts of British America, from Canada to lat. 60°, rare, Dr. Richardson. Found in the Amur and Kamtschatka.

TROLLIUS, LINN.

T. LAXUS, Salisbury.—Sepals 5 or 6, greenish yellow, spreading horizontally, not forming a globose calyx. Petals small, numerous, and much shorter than the sepals and stamens.

Trollius laxus, Salisbury Linn. Trans. T. & G., Fl. N. A., I, p. 28.

T. Americanus, Muhl. Hook. Fl. B. A., I, p. 23.

Sphagnous swamps, Canada to Pennsylvania, T. & G.

Prof. Gray notices this plant as growing in deep swamps in New Hampshire to Delaware and Michigan. It appears to be rare.

There is also an open-flowered *Trollius* in Northern India, Bot. Mag., t. 32, a small dwarf plant like *Eranthis.*

COPTIS, SALISBURY.

C. TRIFOLIA, Salisbury.—Stem very short, with bright yellow fibrous roots spreading from its base. Leaves long-stalked of 3 wedge-shaped, slightly lobed, finely toothed, shining, evergreen leaflets. Flower solitary, on a naked stalk 3 or 4 inches high, petals white, stamens with yellow anthers.

C. trifolia, Salisbury in Linn. Trans. Pursh. Hook. Fl. B. A., I, p. 23. T. & G. Fl. N. A., I, p. 28.

Helleborus trifolius, Linn.

Toronto, 2nd June, 1862, in fl., not common; Halifax county, N. S., abundant in birch woods, G. L. Bass River, Kent, N. B., Rev. J. Fowler. Hudson's Bay Company's Territories, several specimens, Gov. McTavish. St. Augustine, Labrador, 1865, Rev. D. Sutherland, sp. Opposite Gros Cap, June 15, Prof. Bell. Shore of Lake Medad, Hamilton, 17th May, 1860, Judge Logie. Prescott district, common, Mr Billings. Anticosti, July, 1861, Mr Verrill. Gaspé Basin, S. side, June 2, 1862, Dr Bell. Windsor, N. S., Prof. How. Nicolet, Montreal and St. Valentine, Q., and Kingston and Port Robinson, Ont., Dr Maclagan. Belleville, borders of swamps under evergreens, Mr Macoun. Terrebonne and L'Islet, Provancher. Rare in the interior of the western country, certainly not about Lake Winipeg, Mr Barnston.

AQUILEGIA, Tournefort.

A. Canadensis, Linn.—Spurs straight, twice the length of the lamina; petals oblong lanceolate, spreading, nearly twice the length of the lamina; stamens and styles exserted. Follicles downy, with very long thread-like beaks. Segments of leaves trifid, incised. In the Toronto plant the stamens are very much exserted on long slender filaments, much longer than the styles. Flowers bright scarlet, yellow inside, gracefully pendent, but the peduncle becomes firm and erect in fruit.

A. Canadensis, Linn. Michaux. DC. Hook. Fl. B. A., I, p. 24. T. & G. Fl. N. A., I, p. 30. A. Gr. Man. Bot., and Ill. Gen., I, t. 13. C. A. Meyer, Sertum Petropolitanum, under t. 11.

In woods and open clearings, chiefly where the soil is dry and sandy. In woods near Toronto, 2nd June, 1862, a robust, leafy form, much branched from above. Abundant about Kingston, especially near Kingston Mills, Waterloo and Wolfe Island, G. L. Montreal Mountain, May, 1848, and Niagara, Mr J. Adie, sp. Rear of Ernestown, 1860, Dr Dupuis, sp. Caledon, rather rare, Rev. C. I. Cameron. Nicolet, Montreal, Kingston, Niagara River and Malden, Dr Maclagan. Belleville, common in rocky or sandy open woods, Mr Macoun. Pied du Cap Tourmente, Provancher. Lake Winipeg, Capt. Back. Belœil Mountain, Dr Bell. Mountain side west of Hamilton, common, 24th May, 1859, Judge Logie. Prescott district, common, Mr Billings.

Mr Barnston says its zone is between 40° S. and 56° N., beyond which he has not found it.

A. formosa, Fischer, is chiefly distinguished from *A. Canadensis* by the greater length of the sepals, (Sitka, Oregon, Unalaschka, Kamtschatka); and there is another member of the group, but a very distinct one, *A. truncata*, Fischer, remarkable for the petals consisting of spur only without lamina, and the sepals are spread horizontally, (this species is from New California).

A. BREVISTYLA, Hooker.—Spurs incurved, shorter than the lamina. Stamens and styles short, included. Sepals ovate-lanceolate. Flower much smaller than *A. vulgaris*, to which this species approaches very closely in technical characters, although permanently distinct.

A. brevistyla, Hook. Fl. B. A., I, p. 24. T. & G. Fl. N. A., I, p. 30.

Clear Water River, 13th July; Nipigon, 1853; Fort Simpson; also in a parcel labelled "L. Nipigon, chiefly near L. Superior," Governor McTavish. As far north as Bear Lake, Richardson. Mr Barnston never met with but received it from McKenzie River, and says it is very rare to the southward of Winipeg, although "according to some (Richardson) it is a native of western Canada." Rocky Mountains.

A. VULGARIS, Linn.—Spurs incurved like a crozier, shorter than the very broad lamina. Stamens exserted, the inner ones frequently imperfect. Sepals ovate-lanceolate with acute tips, and twice the length of the spurs. Flowers large, variable in colour, blue, purple, white, rose, &c.

A. vulgaris, Linn.

Introduced from Europe. Abundant in the grounds at the Prince's Lodge, Halifax County, and in spots along the Railway Line and Windsor Road, G. L.

DELPHINIUM, TOURNEFORT.

D. EXALTATUM, Aiton.—Leaf petioles not dilated at the base, lamina divided more than half-way into 3 or 5 cuneiform lobes, which are trifid-laciniate, acuminate. Raceme of flowers strict, slightly compound below (panicled); floral spur straight, as long as calyx.

D. exaltatum, Aiton, Hort. Kewensis, ed. 1, ii, p. 244. Pursh. DC. Prod. T. & G. Elliot. Hook. Wood.

Youcon; Clear Water, 13th July, Governor McTavish. Rocky Mountains between 52° and 56°, Hook.

Mr Barnston's remarks on the distribution of this species (Canadian Naturalist, vol. ii, p. 17) are interesting:—"The *Delphinium exaltatum* found in Canada attains to a high latitude, as it passes the barrier or ridge of high land that separates the waters running eastward into Hudson's Bay from those that fall by another course into the Arctic Ocean. In these northern latitudes it is probably confined to the limestone strata and the warmest exposures. I have dried specimens of some size from friends in the north, who gathered them on the banks of Clear Water River. I must own I have not met with it myself between Lake Winipeg and Canada. To me, therefore, this fine plant, like the Hepatica appears to have taken an immense leap of nearly 2000 miles. If there be connecting links along this great distance, where the *D. exaltatum* shows itself, the chain must run to the southward of Lake Superior crossing westward to Red River and from that by the west side of Lake Winipeg and the northern tributaries of the Saskatchewan to the waters of Peace River."

In the United States the distribution of this plant is decidedly southern, Gray giving its *north* limits as Pennsylvania and Michigan.

D. AZUREUM, Michaux.—Leaves with slightly dilated petioles, the lamina 3 to 5 parted and wholly cleft into linear lobes. Raceme perfectly simple.

D. azureum, Michaux, Fl. T. & G. Fl. N. A., I, p. 32.

West of Rocky Mountains between Fort Youcon and Lapierres House; also Youcon (fl. smaller, pedicels and spurs shorter), Governor McTavish.

Var. *b. canescens.*

Lake Winipeg, T. & G.

D. CONSOLIDA, Linn.—Stem erect, branched, leaves deeply multifid, racemes few flowered, spur longer than the calyx, petals combined.

D. Consolida, Linn. T. &. G. Fl. N. A., I, p. 30.

Introduced from Europe. Banks of the St. Lawrence, west of Prescott, Mr B. Billings, Jr.

Excluded Species.

D. Ajacis, Linn., the annual Rocket Larkspur of our flower gardens, was found by Dr Schultz between Wild Rice River and Red Lake River, Sept., 1860, but it is not likely to become permanently naturalized there.

ACONITUM, Linn.

A. delphinifolium, Reichenbach.—Many-flowered, flowers in short loose, sometimes slightly corymbose racemes, with very long pedicels; galea slightly conically-narrowed. Stem wiry, leaves rather shortly petiolate, palmately divided, the divisions incisely cleft; whole plant glabrous, except the pedicels and flowers, which are slightly downy. Flowers bright, not dark, blue, sepals more open than *A. Napellus*, and the plant is more delicate, and of thinner texture.

A. delphinifolium, Reichenbach.

A. Napellus var. delphinifolium, Seringe, in DC.Prod. Hook Fl. B. A., I, p. 26. T. & G. Fl. N. A., I, p. 34.

A. delphinifolium a. Americanum, DC. Syst.

A. paradoxum, Reichb.

A. delphinifolium b. paradoxum, Reichb.

A. Napellus e. delphinifolium lusus b. paradoxum, Regel, Pl. Radd., p. 111.

A. delphinifolium, vars. *a.* and *g.*, Ledb. Fl. Rossica.

Youcon River, near the Arctic Circle, also between Ft. Youcon and Lapierres House (west side of Rocky Mountains), Mr Hardesty. Specimens sent to me by Governor McTavish.

Previously found on the coast of Behring's Strait, and on the Rocky Mountains between 52° and 56° N.

A. delphinifolium var. semigaleatum. — Flowers very large, sepals of thin texture, spreading, galea quite depressed with long acuminate point.

West side of Rocky Mountains, between Fort Youcon and Lapierres House, Governor McTavish, sp.

Regel, in "Plantæ Raddeanæ," Band I, pp. 101 to 114, brings together a large number of described species under the *A. Napellus*, and, amongst others, the present plant; this course necessitates his describing under *A. Napellus* no fewer than forty varieties and forms, which are all carefully named and classified. As our indigenous North Western *A. delphinifolium* is perfectly, and so far as known permanently, distinct from the ordinary forms of *A. Napellus* met with as an introduced plant in the East, I have kept it separate. For purposes of geographical botany it is absolutely necessary to discriminate between these two plants. The massing together of types geographically distinct in cases of this kind has led to much confusion.

A. NAPELLUS, Linn.—Flowers very numerous in long slender racemes, with mostly short pedicels, galea nearly hemispherical. Plant more or less pubescent in the upper part, flowers of a dark blue colour, somewhat lurid before expansion. A stronger, taller, more hairy plant than the two preceding, with very long racemes not at all corymbose. Root of large tubers, whole plant very poisonous.

A. Napellus, Linn.

About old cellars, fences and places where gardens have been,—a remnant of cultivation, but not inclined to spread.

CIMICIFUGA, LINN.

C. RACEMOSA, Elliot.—Tall, with very long erect racemes.

C. racemosa, Elliot. T. & G. Fl. N. A., I, p. 36.

C. Serpentaria, Pursh.

Actæa racemosa, Hooker.

Botrophis actæoides, Fisch. & Meyer.

Cayuga, Grand River, Ont., Dr P. W. Maclagan.

ACTÆA, LINN.

A. RUBRA, Bigelow.—Root fibrous. Racemes depressed ovate, pedicels long and slender. Flowers in May and June, fruiting from July to September.

A. rubra, Bigelow, Fl. Bost. Hook. Fl. B. A., I, p. 27. T. & G. Fl. N. A., I, p. 35.

A. spicata b. rubra, Michaux.

Near Odessa, 10th July, 1861; Portsmouth, near Kingston, 4th June, 1859; Indian Island, Bay of Quinte, 5th June, 1862; Toronto, 2nd June, 1862, G. L. Bass River, Kent, N. B., Rev. J. Fowler, sp. Montreal Mountain, May, 1848, Mr Adie. Malden, Dr Maclagan. Belleville, frequent in rich woods, Mr Macoun. St. Joachim, Provancher. Newfoundland, Barbe's Bay, Aug. 7, 1861, Mr J. Richardson, sp. in fl. Slave Lake, 24th June; York Factory, in ft., Sep., Governor McTavish, sp. Between Wild Rice River and Red Lake River, Sep., 1860; Assiniboine River, July, 1861, Dr Schultz, sp., No. 114. Lake Winipeg, Back.

A. ALBA, Bigelow.—Racemes oblong, the pedicels usually short, becoming very thick as the fruit ripens.

A. alba, Bigelow, Fl. Bost. Hook. Fl. B. A., I, p. 27. T. & G. Fl. N. A., I. p. 35.

A. spicata b. alba, Michaux.

Near Toronto, 2nd June, 1862, G. L. Camden, Co. Addington, Dr Dupuis, sp. St. Helen's Island, Kingston, Thorold, Navy Island and Malden, Dr Maclagan. Belleville, frequent in rich woods, Mr Macoun. Does not pass N. of 53° or 54°, Barnston. Hamilton, Judge Logie. Prescott, Mr Billings. Anticosti, Mr Verrill. Windsor, N. S., Dr How.

In the English *A. spicata* the pedicels are extremely short, the upper flowers almost sessile. *A. alba* is the only form found in the Southern States.

HYDRASTIS, Linn.

H. CANADENSIS, Linn.

H. Canadensis, Linn. T. & G. Fl. N. A., I, p. 40.

Warneria Canadensis, Miller's Dictionary.

Malden, Ont., Dr P. W. Maclagan. Mirivin's Woods, a mile west from Prescott, rare, Mr B. Billings, Jr.

[*Excluded*.

ADONIS AUTUMNALIS, Linn.—Hooker received diminutive specimens of this garden annual from Cape Charles, Labrador, but no doubt the seeds had been introduced, and there is not the least probability of the plant having established itself.]

ART. III. ON THE LARIDÆ OF THE NOVA SCOTIAN COAST. BY J. MATTHEW JONES, F. L. S.

(*Read December* 13, 1869.)

ACCORDING to the catalogue of North American Birds published by the Smithsonian Institution, I find the following species of *Laridæ* inserted, as having been observed on the North-east coast of this continent. 1. Pomarine Skua (*Stercorarius pomarinus*, Temm.) 2. Glaucous Gull (*Larus glaucus*, Brünn.) 3. White-winged Gull (*L. leucopterus*, Fabr.) 4. Great Black-backed Gull (*L. marinus*, Linn.) 5. Herring Gull, (*L. argentatus*, Brünn.) 6. Ring-billed Gull (*L. Delawarensis*, Ord.) 7. Bonaparte's Gull (*Chroicocephalus Philadelphia*, Ord.) 8. Kittiwake (*Rissa tridactyla*, Linn.) 9. Ivory Gull (*Pagophila eburnea*, Kaup.) 10. Fork-tailed Gull (*Xema Sabinii*, Bon.) 11. Wilson's Tern (*Sterna Wilsoni*, Bonap.) 12. Arctic Tern (*S. macroura*, Naum.) 13. Least Tern (*S, frenata*, Gambel.) Of this list of thirteen species nine have been identified by myself, and one by Major Wedderburn, (late 42nd Highlanders,) as occurring on the coast of Nova Scotia, and seven of these are in my own cabinet.

The ten species identified as Nova Scotian up to the present time, are *Stercorarius pomarinus*. *Larus glaucus*. *L. marinus*. *L. argentatus*. *L. Delawarensis*. *Chroicocephalus Philadelphia*. *Rissa tridactyla*. *Pagophila eburnea*. *Sterna macroura*. *S. Wilsoni*.

To this list, it is probable, several other species may be added in the course of time, but in a country like this where the naturalist must rely almost entirely upon his own exertions, to secure specimens and note their haunts and habits, the task of forming anything like a complete list of the several members of any zoological family is not an easy one. I therefore trust my present brief account of the Laridæ frequenting the coast of Nova Scotia may merely be received as the commencement of one more complete.

FAM. LARIDÆ.

SUB-FAM. LESTRIDINÆ

1. POMARINE SKUA.

(*Stercorarius pomarinus*, Temm.)

Lestris pomarinus, Rich.
L. striatus, Eyton.
Cataractes pomarinus, Gould.

This bird occurs but rarely on our coast, and literally nothing is known of its habits. A specimen which is in my cabinet was shot at Digby, on the Bay of Fundy shore, after the heavy gale of Oct. 4, 1869, by Mr. W. Gilpin, and kindly given me by his father, Dr. Bernard Gilpin.

SUB-FAM. LARINÆ.

2. GLAUCOUS GULL OR BURGOMASTER.

(*Larus glaucus*, Brünn.)

This fine gull is another rare visitant with us, and only observed in the winter season. The only specimen in my cabinet was shot at the entrance to Halifax harbour by Mr. W. Gilpin. It is found throughout the Polar seas, and has been observed, according to Baird, as far south as New York.

3. GREAT BLACK-BACKED GULL.

(*Larus marinus*, Linn.)

Larus niger, Briss.
Dominicanus marinus, Bruch.

This bird which is known as the "saddle-back" or "saddler" among the fishermen, is a common species with us, and frequents the sand flats in our estuaries and harbours at ebb tide, and, as is usual with gulls, will stand on a flat until the rising water compels it to seek another spot. It is a wary bird, and by no means easy to get a shot at. It breeds on islands off the coast, sometimes in trees, and sometimes on the cliffs. It appears to have an extensive geographical range on this continent, being found on the coast of Greenland and as far south as the Gulf of Mexico. The young of this species, in their immature plumage, have been taken in the Bermudas.

4. Herring Gull.

(*Larus argentatus*, Brünn.)

Larus fuscus, Penn.
Laroides argentatus, Bruch.
L. argentatoides, Rich.

This may be considered the most common species on the Nova Scotian coast. It breeds in similar positions to the last, and old and young frequent Halifax harbour, particularly in winter, (which very rarely freezes like others in Nova Scotia,) skimming the water in search of food. The young with their light brown plumage are so dissimilar in colour to the old birds that the fishermen take them for a different species. Small flocks visit the Bermudas in the winter months. Its geographical range on the east coast of America is from Greenland to the Gulf of Mexico.

5. Ring-billed Gull.

(*Larus Delawarensis* Ord.)

Although known on our coast, of the habits or distribution of this species we possess but meagre information. I am inclined to think that this is the species which I have observed keeping company with the steamer the whole way across the Atlantic. It is common to both continents. In the Bermudas it occurs at long intervals in the winter season.

6. Bonaparte's Gull.

(*Chroicocephalus Philadelphia*, Lawr.)

Larus Bonapartei, Rich.
L. capistratus, Bonap.
Sterna Philadelphia, Ord.
Chroicocephalus Bonapartei, Bruch.

This pretty little gull is by no means uncommon during the autumn months, and is named "Mackerel Gull," from its appearing on our coast about the commencement of the mackerel season. It goes northward to breed during the summer months, and returns to us with its young about September and the beginning of October. These gulls are fond of associating together in flocks, moving from one place to another as the tide ebbs and flows, leaving on the sand flats or gravelly beaches, those little pools, wherein the small fry of fishes, and different species of crustaceans are always present, and on which these little birds principally feed. In the month of October they are very fat, and the flesh is by no means to be despised; indeed, far preferable, I think, to that of our dry and insipid ruffed grouse (*Tetrao umbellus.*) It is found in the most northern parts of the Hudson's Bay Territory, and in the Bermudas we find it not uncommon in winter time. According to Baird it is also found on the Pacific coast of America.

7. Kittiwake.

(*Rissa tridactyla*, Bonap.)

Larus tridactylus, Linn.

L. rissa, Brünn.

This species, so often noticed by Arctic voyagers, as occurring abundantly in all parts of the Polar sea, is not uncommon on our shores in autumn and winter. It goes north to breed.

8. Ivory Gull.

(*Pagophila eburnea*, Kaup.)

Larus eburneus, Gmel.

L. candidus, Fabr.

Only one specimen of this Arctic species, as far as I am aware, has been observed on our coast. It was seen by Captain Wedderburn, (42d Royal Highlanders,) some years ago, in Halifax Harbour.

Sub-Fam. STERNINÆ.

9. Wilson's Tern.

(*Sterna Wilsoni*, Bonap.)

Sterna hirundo, Wils.

S. major, Briss.

Hirundo marina, Ray.

Common on our coast. It breeds on low uninhabited islands in our bays and off the coast. Dr. Gilpin informs me that it also breeds in great numbers at Sable Island, some 90 miles out at sea.

In the Bermudas, on a rocky islet, known as Gurnet's Head, these birds also breed annually. Temperature must be slightly regarded by them during nidification, for while on the Nova Scotian coast, they sit and rear their young, when at nights the thermometer sometimes falls as low as 37° ; in the Bermudas, they are similarly occupied on sandy rocks, exposed to a blazing sun, which, even in sheltered spots on shore, raises the temperature to 87° in the shade.

10. Arctic Tern.

(*Sterna macroura*, Naum.)

Sterna arctica, Temm.

This bird, known as the "steering gull" or "steerings" by the fishermen, is very common with us ; especially during the breeding season, from the middle of June to the first week in July, when it frequents the small grassy islands in the harbours and shore waters for the purpose of nidification. The nest, if such it can be called, is a mere depression in the earth on the side of a bank, about four inches diameter, with a few bits of dry grass within, on which rest the eggs of very varied colour. Many thousands of young arctic terns must be hatched every summer on our coast. Regarding the habits of these birds as observed by my friend, the Rev. John Ambrose, of St. Margaret's Bay, he thus proceeds in a recent letter :—"They are the most affectionate birds (conjugally speaking) in this country, and greatly remind one of the so-called 'love birds' in this respect. They are almost invariably seen flying in couples or *even* numbers. I have often observed them sitting in couples on buoys or detached rocks, billing and caressing each other, in the most affectionate way, cooing the while in their peculiar manner. Some time ago, when passing a rocky point in a boat, a loaded gun being at hand, a pair of terns flew past, I fired and shot one, when the other immediately flew to the succour of its bleeding and helpless companion, swooping close to it and touching it at times in passing. Its grief seemed so violent, that in sheer pity I fired, and it dropped beside its dead mate, all its sorrows at an end. Since that day I have never fired at a tern."

11. Roseate Tern.*

(*Sterna Paradisea*, Brünn.)

Sterna Dougalli, Mont.

I insert this species on the authority of Mr. Thomas Egan, Taxidermist, of this city, who assures me that a specimen was obtained recently, and is now in the possession of Mr. John Roue, of Halifax. Baird gives New York as its northern limit.

Art. IV. Providential Warning to the Lower Animals. By Rev. J. Ambrose.

(*Read February* 14, 1870.)

"I feel it in my bones," is a phrase which, it seems to me, must have originated in some cold country in which rheumatism was not uncommon. For it is well known that rheumatic persons, as well as those whose bones have at any time been broken or severely sprained, are more or less affected in the diseased or injured part by marked changes in the atmosphere. A joint, as I know by experience, weakened by a severe sprain, gives warning of an approaching snow or rain-storm by a sort of warm, uneasy and even sore feeling,—though the sprain was apparently healed several years before. Corns and bunions on the feet also give their proprietors timely notice of approaching storms. Knowledge of this kind may be desirable if it be not too dearly purchased, and I have at various times been warned against what turned out to be inconvenient and dangerous journeys by my prophetic ankle, a barometer which is never forgotten and left at home when its owner goes abroad :—

"O my prophetic soul! my *ankle*." [*Hamlet.*]

Second-sight, among the Highlanders, is said to have been almost invariably accompanied by a peculiar, and indeed what might be called a diseased state of the nervous system. Weather-

*Just as this paper is going to the press I am enabled to add this new species.
J. M. J.

prescience, as I have shown, is oftentimes accompanied by pain and uneasiness. All men are not gifted with this peculiar kind of foreknowledge, but it is of a sort not likely to excite envy: "Where ignorance is bliss 'tis folly to be wise."

Man, with his large brain and his habits of observation and vast stores of recorded facts, from which he may construct almost infallible rules, may make shrewd guesses at a coming storm without "feeling it in his bones." But the lower animals not being gifted with the higher sort of reasoning power, and requiring food and shelter "for the rainy day," as we say, are seldom or never found unprovided. By a sure instinct they seem even to know beforehand the length and severity of the approaching winter, so that they may lay up their stores accordingly. It is evidently not by hap-hazard they live. ONE who works by means provides even for the meanest of His creatures, and as their reasoning powers are not equal to that of man, their physical susceptibility may be, and I think likely, is very far greater than his, so as to give them, not merely a few hours, but perhaps months of warning as to the variations of weather and duration of heat or cold. This I think is proved by the varying quantity of their winter stores, and the greater or less amount of care bestowed by the same animals at different seasons on the provision which they make for shelter for months to come. It has, for example, been remarked by Canadian hunters, as well as by our own Indians, that the beaver and musk-rat show in this way a foreknowledge of the mildness or severity of approaching winter

I had the opportunity in 1852 of observing the habits of a pet bear, which was owned by a gentleman in Liverpool, Nova Scotia. No barometer could more surely indicate an approaching storm than could this apparently stupid animal. Always before a storm he would betray a good deal of uneasiness, and this uneasiness, I always thought, was proportioned in length and intensity to the severity of the coming change of weather. Once in particular poor Bruin's trouble "in his bones" must have been very great. He ordinarily took the world very easy, looking carefully after his meals, but between times basking in the sun, or contriving plans, not unfrequently successful, of appropriating some nicety from the larder or preserve closet. But this day in particular, all ordinary pursuits were laid aside, and his mind was full of coming trouble. All day long he was pacing up and down, making most lamentable noises and shaking his head from side to side. These, though in a far more mitigated degree, were his ordinary methods of showing that he "felt in his bones" a coming storm. And accordingly, some twenty-four hours after Bruin's troubles began, a terrible storm of wind was raging along the coast, and several vessels were wrecked in the harbour and roadstead of Liverpool.

An old hunter who lives at the head of this Bay informs me, that Moose are more apt to roar or "call" immediately before a storm than at other times, as from his house he can frequently hear them.

Signs of a coming storm exhibited by ordinary domestic animals, are almost too well known to require enumeration. Geese leaving their ordinary "goose-step" and betaking themselves to vociferous flight. Cats gambolling in an unwonted manner. Pigs carrying straw in their mouths. These and many other such indications among our more humble dependents, have not only been noticed by the vulgar, but recorded by poets in immortal verse.

Spiders and other insects also give warning by some marked change in their ordinary occupations, or mode of concealment, that a change of weather is at hand. The Rev. Gilbert White mentions the susceptibility of the house-cricket, (*Gryllus domesticus*,) in this particular, though observing at the same time that the housewife superstitiously credits it with prescience in other more recondite matters.

Why should we not expect to find a susceptibility to atmospheric changes among land animals, when it is well known that fishes, more out of the ordinary power of the atmosphere as one would think, give sure indications of its influence upon them. A change of wind will be indicated by mackerel, herring, dog-fish or cod, particularly by the three first-named. A wind blowing from the S. E., S. or S. W. will, as our fishermen say, bring them into this Bay, whilst a N. wind will, almost invariably, drive dog-fish off. Porpoises rise to the surface in an unwonted manner before a storm, and our people remark that they roll towards the direction from which the storm is to come. It is but fair to say, however, that these general movements among fishes may be occasioned by the "ground-swell," which, as is always remarked, is felt some time before the storm which occasions it, as the displacement of the water travels faster than the wind which causes the displacement.

It may be that by some such indications in their physical susceptibilities, birds of passage are warned and impelled to undertake their semi-annual migrations. An uncontrollable uneasiness may thus take possession of whole flocks at once, not to be satisfied or mitigated but by a long flight in one particular direction. This uneasiness may perhaps be felt by some individuals in a very slight degree, owing to some natural defect or other cause,—hence the presence of the very few such birds which remain with us over winter.

These curious facts however, prove that to a certain extent, the lower animals can deduce effect from cause, and *vice versa*, and therefore that many, not only of the larger animals, but some far lower in the scale of creation than is generally supposed, can in a humble way, reason and provide against ordinary dangers.

"Go to the ant, thou sluggard, consider her ways and be wise." "The locusts have no king, yet they go forth all of them by bands."

* * * * * * * * * *

A well authenticated story of what I may call the reasoning power of a dog, and which moreover has never appeared in print, may bring these remarks to a conclusion. A member of a family residing in Liverpool, Nova Scotia, some years ago, was one night taken suddenly and severely ill. A Mrs. Nickerson, skilful in such cases, resided at some considerable distance from their house. "Ah!" said the father of the family, "how much I wish we had somebody able to go for Mrs. Nickerson, I cannot leave the house." At this the dog went to the door, whined and scratched until let out. Shortly afterwards Mrs. Nickerson hearing a whining and scratching at her own door, found on opening it that this dog was there, acting in an importunate and beseeching manner, making short runs backwards and forwards between her and the direction towards his master's house. Feeling sure that something must be the matter there, the good woman went to the house and was joyfully received by the family, who informed her how anxiously they had been wishing for her presence, but had no messenger to send for her. "There was a messenger," said she, "and one that would not be put off. Your dog came for me."

The means by which the lower animals are warned of far-distant events, and the extent to which their reasoning powers may be carried are subjects yet open to much investigation, and which, moreover, may do much to lead the inquirer from Nature up to Nature's God.

Lord Milton, in his book on the "Nor' West Passage," mentions that one of his party having killed a skunk, *(Mephitis Americana,)* some time after they built the hut in which they passed their first winter in the Red River Territory, threw the carcase of the animal out on the snow, not far from the hut. During the remainder of their stay at that camping ground the carcase of the skunk always gave notice of an impending storm, being at such times highly odoriferous, whilst during the settled weather its disagreeable effluvium was not perceptible.

A fact precisely similar came under my own observation during the winter of 1867. One of my parishioners killed a skunk in the autumn of that year, and threw the carcase (without skinning it) into the bushes skirting the road between French Village and Hosier's River. During that winter and the greater part of the following summer—indeed so long as any part of the skin or muscular system of the animal remained—I invariably noticed in passing that my olfactories were faithfully warned of every approaching storm by the sensitive carcase in the bushes. I have now in my possession part of a skunk's skin which has been dressed by a furrier, but still retains, in a remarkable degree, this forecasting peculiarity.

If the bodies of animals, even—as in some cases after death—show so remarkable a sensitiveness to atmospheric changes, we may well suppose that this sensitiveness may be one means by which a kind Providence warns the lower animals to provide in their native land, against the rigours of winter, or secure by periodical and timely migrations their necessary food and comfort.

Another means by which the habits of animals are regulated and varied is the change of outward circumstances. In Europe, for example, beavers generally live alone and burrow in the ground, but in America they are found in communities and regularly constructed dwellings. Some have consequently supposed that this difference of habits is a proof of difference in species. But communities of beavers are found in Europe, and solitary beavers in America. The truth is, the species is the same, but their habits are changed by change of circumstances, for amid the busy haunts of men where communities of fur-bearing animals would be broken up, the solitary burrowing system prevails among beavers, whilst in the vast solitudes of America communities are the rule, though, in the neighbourhood of man, solitary and burrowing beavers are more frequently found.

From the foregoing and multitudes of similar facts which may be gathered from persons of ordinary powers of observation, it is obvious that the lower animals can reason to a certain extent. May I venture to hint at the probable boundary which divides their reasoning power from that of man?

Man's nature consists of body, soul and spirit,—or, in other words,—body, mind and soul; whilst the soul is absent from the nature of the lower animals, though the faculty of mind they possess to a less extent than man. It is but a truism to say that the natural desire of man and beast is to satisfy the *whole* nature. The soul, man's immortal part, cannot be satisfied in this mortal state,—hence happiness in the soul can only be obtained by a course looking to a future and immortal state, and therefore, in many respects, at variance with his present mortal nature. This accounts for man's naturally restless and consequently inventive disposition, especially in a civilized state. "God hath made man upright, but they have sought out many inventions." It is the soul—the stronger reasoning power, which stimulates and assists the operations of the mind.

So also the object of the lower animals is to gratify the desires and supply the wants of their *whole* nature, and to provide for their safety. Hence we find them able to provide for future wants, and to change their habits of life according to circumstances. But not being stimulated by the wants and aspirations of the immortal part, their inventive power is exceedingly limited. Man in the savage state, in which the aspirations of the soul are repressed, blunted and never educated, thus approaches nearly to the condition of the brute. The higher nature within him, however, being misdirected employs its half-dormant energies in the gratification of the bodily instincts. Hence the wickedness of man as contrasted with the innocence of the brute creation.

According to this view, the reasoning power in the lower animals may be cultivated to a far greater extent than is generally supposed, thus opening a wide field of instruction and pleasure to the true naturalist, who knows that God's works are great—"sought out of all them that have pleasure therein."

Art. V. On Agates. By A. S. Foord.

(*Read February* 14, 1870.)

Encouraged by the very flattering reception accorded to my paper on "Gems," which I had the honour of reading before the Institute in February last, I have been induced once more to take up my pen and pencil, trusting that my endeavours on this occasion also, may not be unsuccessful.

Agates are among the most attractive objects that grace the cabinet of the collector. The variety of colours which they present, and the brilliant polish of which they are susceptible, enhance their value, while they display to advantage the exquisite markings so characteristic of the agate.

In some groups the colours are distributed in clouds, spots, or concentric lines: in others in bands of various hues, as in *Ribbon Agate;* while in not a few the markings are produced by parallel deposits of chalcedony—represented in that variety called "*Fortification*" *Agate*, in which some of the layers are zig-zag, like the lines of a fortification. Agate is a variety of *chalcedony*, and often occurs lining or filling cavities in amygdaloidal and other rocks, or scattered over the surface of the soil, or in the beds of torrents and rivers.

The agate derives its name from that of the river Achates in Sicily, whence, according to Theophrastus, it was first brought. The most common kinds are of a light greyish-blue or dove colour, passing into deeper shades of blue.

In examining a section, such as Fig. 1, it will be seen that the deposits of chalcedony, (which are usually concentric), commence with a small spot or nucleus in the centre of the amygdaloid, increasing in diameter as they approach the sides of the cavity, with spaces varying in width between each deposit.

" The origin of the amygdaloidal structure cannot be doubted, for we may trace the process of its formation in modern lavas. Small pores or cells are caused by bubbles of steam and gas confined in the melted matter. After or during consolidation, these empty spaces are gradually filled up by matter separating from the mass, or infiltered by water permeating the rock. As these bubbles have been sometimes lengthened by the flow of the lava before it finally cooled, the contents of such cavities have the form of almonds.

" Amygdaloid comprehends any rock in which round or almond-shaped nodules of some mineral, such as *agate*, chalcedony, calcareous spar, or zeolite, are scattered through a base of wacké, basalt, greenstone, or other kind of trap."*

Mr. Jackson describes, in the following terms, the appearance of " *Eyed Agate* " and *Ribbon* or *Banded Agate*:—

" Some agates seem to have been formed by a bundle of cylinders enveloped in a sicilious paste, the cylinders themselves being formed of concentric accumulations. When such an agate is cut in a direction perpendicular to the cylinders, it exhibits a multitude of circular figures, bearing some resemblance to the iris and pupil of the eye,—whence this kind is called Eyed Agate; but if the stone be cut in a direction parallel to the axes of the cylinders, we have a suite of more or less delicate parallel lines, in which case it forms a Ribbon or Banded Agate."

Moss Agate or *Mocha Stone* is generally of a brownish colour, translucent at the edges, and having a very distinct conchoidal fracture, and sharp cutting edge; the moss-like or dendritic markings are opaque and of a yellowish-brown colour. They are caused by oxide of iron, disseminated in efflorescent particles here and there throughout the mass.

Dr. Bowerbank, some twenty-five years since, investigated the subject of agates with much success, and has shewn that the heliotrope (*bloodstone*) of India, and many of the so-called moss-agates, are due to a spongy nucleus.

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*Sir Chas. Lyell's " Elements of Geology."

Agate-jasper, as the name implies, is a blending of agate and jasper, in patches or veins of various thickness,—the jasper usually predominating. The author possesses a specimen in which a brown jasper (as figured), is intersected by a broad vein of agate; the jasper being also traversed by narrow veins, which mingle with the large vein of agate by means of channels or inlets. These red veins are owing to the action of heat, which has rendered the iron contained in the jasper *anhydrous*.

The drawing numbered 1, represents a section, viewed edgeways, of an amygdaloid, popularly known as Fortification Agate, wherein is displayed that interesting phenomenon to which I have alluded, namely, infiltration. In this specimen the chalcedony apparently entered the amygdaloid, and penetrated the regular layers from the upper part of the geode, forming the lines of the fortification, resulting in the cloudy appearance observable in the stone.

Brecciated agate or *breccia agate* consists of fragments of *jasper*, *bloodstone*, *carnelian*, &c., cemented by a paste of chalcedony.

Agates are found in great abundance in different parts of the world, especially where trap rocks occur.

They are met with in great variety at Oberstein,* near Coblentz (in Rhenish Bavaria), in a rock of amygdaloid of a peculiar nature, and full of cavities of all sizes.

Some very beautiful articles were exhibited at the Exhibition of 1851 from the above locality, and obtained prize medals.

The agate trade at Oberstein and Idar has lately undergone a singular change, in consequence of a falling off in the supply of the agate nodules. The agates now worked in that district, and sold as native productions, are chiefly obtained from the Brazils, where, (on the Paraguay, brought down from the interior by the Rio de la Plata,) they are in such abundance as to be shipped for ballast.

*Oberstein is beautifully situated on the left bank of the Nahe, shut in by high and romantic cliffs, chiefly of porphyry and amygdaloid, abounding in agates and crystals. The existence of these probably gave rise to the importation of other half-precious stones, of finer quality, from the East Indies and Brazil, *in the rough*, which are here cut and polished. This business occupies a considerable number of the 3000 inhabitants. The stones are ground and polished by means of grinding-stones of red sandstone, moved by water-wheels in numerous small mills scattered along the neighbouring streams. There are large polishing mills at Idar, one-and-a-half miles off. Close to Oberstein are two fine precipitous rocks, &c.—*Murray's Hand-Book—Northern Germany.*

Notwithstanding the source of supply is so remote, agate articles are sold in Germany at prices astonishingly low. One other fact in connection with the agate frauds may be worth recording. Upper Egypt is known to yield agates, though different from those of South America, and much less abundant. Travellers from Europe in passing through that country enquire for these; and, to meet the demand, Brazilian agates are now sent to Egypt, and there sold for Egyptian agates. At Cairo, especially, numbers are thus disposed of to English and other travellers, who purchase them as souvenirs of the country.

India furnishes many of the finest specimens, where they are largely employed in the decoration of the celebrated Mausoleum of the favourite wife of the Mogul Emperor Shah Jehan. This unique monument is internally surrounded with borders in the form of garlands of exquisite taste, entirely composed of agates, jasper, carnelian, lapis lazuli, &c.; the stones being let into the white marble in the manner of the Florentine Mosaics. The agates, &c., used, are said to be the produce of different countries of India, and are of the finest quality.

The occurrence of agates in Scotland will be familiar to all who identify them with the pretty "Scotch Pebbles," set in silver, and made into brooches, bracelets and other ornaments.

Alger (the American Mineralogist) observes that "specimens recently brought from Nova Scotia will vie in beauty with any from the most noted localities."

I have in my own collection a handsome piece of moss-agate from Five Islands, in the Bay of Fundy, whose shores abound, in certain spots, with the finest specimens of this attractive stone. I have attempted to pourtray the above named fragment, in the drawing numbered 2, but with, I fear, small success. The rich colour and varied surface of the mineral, added to its semi-translucence, make it most difficult to represent in a diagram, with any degree of accuracy.

Many jewellers colour agates artificially by placing them in a solution of oil, (of 200° temperature); after reducing it to 60° they are transferred to a vessel containing sulphuric acid, which decomposes the red sulphate of iron, changing the stone from a pale grey, or dove-colour, to a rich brown or black tinge.

Some agates are very curious, in as much as they represent, frequently with remarkable accuracy, faces, figures and other objects. Pliny speaks of an agate belonging to King Pyrrhus which represented the nine muses with Apollo in the midst holding a lyre; the whole being most perfect, though a mere freak of nature. Majolus informs us that there is in Venice an agate on which is the figure of a man thus drawn by the hand of nature. It is also said that in the Church of St. John, at Pisa, there is a stone of the same kind, representing an old hermit in a desert, seated on the banks of a stream, and holding in his hand a little bell, just in the way St. Anthony is generally painted. These singular accidents are not, however, peculiar to the agates. There is in the British Museum an Egyptian jasper broken in two, and on each piece is a profile of Chaucer the poet.

But however curious these freaks of nature may be, and however pretty, being only accidental, they are far less interesting to the mineralogist and the true lover of nature, than those forms which are her ordinary production.

We must, I think, turn to chemistry for satisfactory accounts of the formation of agates, but if any of the members of our excellent Institute feel an interest in the subject they have ample means of prosecuting their researches in Nova Scotia.

LONDON, Dec., 1869.

ART. VI. NOTES ON IRON DEPOSITS ON EAST RIVER IN THE COUNTY OF PICTOU, N. S. BY REV. D. HONEYMAN, D. C. L., F. G. S., *Member of the Geological Society of France, &c.*

(*Read March* 14, 1870.)

THIS subject cannot be said to be new, as Dr. Dawson, and writers on geology who have derived their information more or less from his writings, have repeatedly directed attention to the subject. In a report of a Geological examination of certain districts in Nova Scotia made by the authority of the Provincial Government, I made observations on one of the deposits, and in a letter to the

Morning Chronicle, which was copied in several of the newspapers, I directed attention to some new facts which came under my observation last summer, while engaged in that part of the County in the service of the Geological Survey. After finishing the work prescribed for the season by the Director, Sir W. E. Logan, I spent the month of September in making the examination of which I now communicate the results. Dr. Dawson, in "Acadian Geology," 2nd edition, page 591, observes: "In addition to these veins of iron ore, conformable beds, as already mentioned, exist in the upper Silurian slates, more especially on the East River of Pictou at the locality indicated on the map. At this place one bed appears to be forty feet thick, and much resembles that in the Devonian at Nictaux, but the ore is more silicious and contains only about forty per cent. of metal. This great bed of ore is especially worthy of the attention of capitalists engaged or about to engage in smelting operations, as it is only ten miles distant from the Albion Coal Mines, and is in the vicinity of abundance of limestone and building stone. The hematite and clay iron stone of the same region might also be profitably used with the specular ore of the great bed." This bed lies in what is called *Blanchard*, and is confined to the farm of —— McDonald. At the barn it has its greatest width as well as its limit; near the north side of the barn it has been exposed for some depth. This is the part where the fossils prevail in the ore. The width diminishes as it proceeds northerly; it bifurcates with intersecting slates, and disappears before reaching the adjoining farm. There are strata at some considerable distance to the north which have been supposed to be a continuation of the bed, but they are only red slates. The question then is what is its depth? The bed dips at a high angle, and the depth can only be ascertained by sinking. With two or three exceptions all the fossils that I collected from the bed are casts. The ore and the fossils resemble those of a small bed of iron exposed on the side of Arisaig Brook, in the township of Arisaig, in Antigonish County. This bed is on the *Clinton horizon*. In the Blanchard bed there are fossils which correspond with those of a still lower horizon, or what I have been in the habit of naming since 1864, A Arisaig, *vide* Journal of Geological Society, November, 1864. Dr. Dawson has suggested that this be called the lower Doctor's Brook, and the next, B, the upper Doctor's Brook, in order to avoid confusion, as he has already named my C and D upper and lower Arisaig. The Clinton equivalent as my C being his lower, and, the lower Helderberg equivalent as my D his upper. I may remark that although the Doctor's Brook series commence at Doctor's Brook which lies to the west of Arisaig, and is still situate in the *township* of Arisaig. They are better represented at Arisaig itself than at Doctor's Brook, while A, or lower Doctor's Brook, is best represented at Doctor's Brook and the cove to the westward of it.

The fossils that prevail in the East River Iron bed resemble the fossils of lower Doctor's Brook age that prevail in the Lochaber Lake locality rather than at Doctor's Brook itself, or of the equivalent strata at Sutherland's River which I discovered last summer, where they abound along with the fossils that prevail at Doctor's Brook. The slates underlying the iron bed have furnished only casts of joints of encrinites. To the west of the bed, on John McDonald's hill, are synclinal strata with Upper Arisaig fossils. To the south the strata containing the iron become highly metamorphic, being underlaid by greenstone. These extend to East River, the strata being often ferruginous. The overlying soil contains numerous pieces of brown hematite, appearing to indicate a recurrence of the bed in a metamorphosed state. At the river the greenstone outcrops in huge dimensions. On the opposite side of this band of greenstone or anticlinal to the iron bearing slates, and at some distanee from the greenstone, with a marsh intervening, is a band of slate with abundance of crinoid joints, and also a trilobite found in the Lower Arisaig or Clinton strata; this band proceeds onward towards East River. I expected to find the specular iron ore of McDonald's, on the opposite side of the river, to be a continuation of the Blanchard iron. I found, however, that Dr. Dawson was correct in inserting a carboniferous series between them which effectually separated the two. This carboniferous series, as it intervenes between the two series of iron bearing strata on either side of the river, consists of crystalline limestone and uncrystalline, lying on the Silurian slates on the Blanchard side, a few paces from the foot of the greenstone mountains of limestone, with angular stones set in the lime in a pasty form, resting on the greenstone in an elevated position at Kennedy's, at the end of the eastern road to Blanchard, and then in a bed of limestone which outcrops on the north side of the rise at McDonald's, at Pleasant Valley, and then crosses over to the south side, where it forms lofty walls on the side of the river above the bridge, and then repasses to the north side, between the presbyterian church and school house, where it lies *directly* and *unconformably* on other Silurian slates, as in other parts of East River, and at Springville. It disappears in the bank at widow Chisholm's, and reappears for the last time about ½ a mile farther up the river on the same side and on the north side of the bed. This forms the termination of the carboniferous formation in this direction. Above this all is Silurian. Here it is divided into two portions, that on the north side of the river has been thrown into numerous folds, each anticlinal having its greenstone axis. This extends to Springville in one direction, and to Sutherland's river falls, at Parker's mill, in another.

The other portion, separating at McPhee's, passes over the river and trends along its side in a broken anticlinal fold, until we come opposite to the first Blanchard series. It is generally covered with drift material and is exposed in four places only, until we meet McDonald's iron deposit, and in every place the strata have a general S. W. strike, with variation. After separating we find this portion making its first appearance on the opposite bank of the river, below the bridge, near McPhee's. It is here a black laminated shale leading some to infer the existence of coal in the locality; it dips from the river, shewing it to be on the opposite of the anticlinal farther down the river on the site of a saw mill. The exposed strata present the same features, the strike and dips being a little different. Farther down, below Pleasant Valley, is another brook with a saw mill; here we have strata exposed having the same characters as before, with the addition of a lower belt of strata, which are compact and of a lighter colour or grey. I at once recognized the two as the upper and lower Doctor's Brook equivalent. Next, opposite the greenstone mountain, crystalline limestone, &c. In McDonald's brook we find the two well exposed, dipping nearly as formerly, having, towards the river an obscure interval, and then the other series of the anticlinal dipping towards the greenstone mountain. This series consists of metamorphic slates with micaceous iron films, succeeded by dark coloured slates having upper Doctor's Brook fossils. These reach to the side of the bridge of the road along the south side, narrowing the distance between these and the greenstone mountain opposite to ¼ of a mile, according to measurement, so that the carboniferous band is somewhat narrow.

The lower strata of this anticlinal band extends to the S. W., and outcrops on the N. E. side of the road that leads to McDonald's, where it is underlaid by a greenstone rock which forms the axis of the anticlinal. The next outcrop of the black band is at McDonald's where the specular ore is found. I consider that I was very fortunate in meeting with the small exposure of anticlinal strata with fossils, as it proves beyond question that, although the ore at Blanchard and that at McDonald's cannot now be connected, they are on the same geological horizon, having been originally formed about the same period.

The details of structure to which I have directed your attention are exhibited on the copy of the plan which I prepared for the Geological Survey. The plan is on the scale of 2½ inches to the mile.

The third deposit of iron ore appears to be the most important on account of its situation, the quality of ore and its probable extent. It lies nearest to the line of railway between Pictou and Halifax. The ore is brown hematite of excellent quality. The extreme end of the bed is two miles above Springville, and the nearest one mile. Last summer the bed was uncovered near its extreme end, exposing a fine bed of hematite about nine feet in width imbedded in metamorphic Silurian slates at a distance, from a hard and lofty exposure of greenstone similar to that of Blanchard, with abundance of films of micaceous oxide of iron. These and other features show that this bed is on the same geological horizon as the other two deposits already described. I found the strike of the imbedding strata; their consequent course considerably differed from what I previously supposed it to be. Masses of the ore are found scattered onward for a distance of two miles, the length of Springville. At Springville, on the property of the late Rev. A.

McGillivray, these are very abundant, and present such an appearance as to have led me for years to entertain the decided opinion that the deposit was on a particular spot of that property, but covered with much drift material. The only difficulty that appeared to militate against the supposition was that the strata underlying and supposed to contain the ore were not highly metamorphic, and contained fossils of Upper Arisaig in good preservation. I found, on making a plan of the district for the Geological Survey, that fossiliferous beds at McGillivray's were considerably in advance of the strata containing the exposed ore. That the course of ferruginous strata was, though a wilderness, lying to the N. E. of McGillivray's, and that they outcropped considerably in the rear of McGillivray's, or about two miles from the exposed outcrop. The occurrence of the masses and the appearance of the soil on a road crossing the wilderness, are indications of the continuation of the beds in the direction specified. Beyond McGillivray's the whole series appear to change their strike as they proceed northward, and a strict examination failed to discover a farther continuance of the bed of hematite, so that there is no sufficient reason to suppose that the length of the bed is more than two miles. I had once hoped to be able to connect this with McDonald's specular ore, as I afterwards expected to connect Blanchard, but the continuation of the carboniferous area already referred to, existing and widening out in this direction as well as other reasons, show that the hope was delusive. From what I have said it will be evident that they are all on the same geological horizon, and were once in a manner united; but in consequence of upheavals and subsequent geological changes they are now completely separated. Theorists have advanced the same opinion as has been done in regard to the hematites of Londonderry mines. This opinion is that it must necessarily be confined to the depth of a few feet. I met this view of the hematite in a former communication to this Institute, by the fact that a level cutting the Londonderry beds at a depth of 100 feet from the surface shewed the ore as still hematite. In addition to this Mr. Jones, the manager of the Londonderry iron mine, in answer to inquiries has informed me that he has proved the beds to the depth of 200 feet, and found the ore still hematite, so that any theory of this band implying limited depth at East River is completely untenable.

There is only one other locality in the whole Silurian series, between East River and Merigomish, where there is any indications of the existence of iron ore. Near Sutherland's River, on the road to New Glasgow, I found a boulder of an oxide of iron slightly resembling the Blanchard ore. This was found where rocks occur on the same geological horizon as those including the beds that I have already described.

Art. VII. On Meteorological Observations for 1869. Caledonia Mine, Cape Breton. By Henry Poole.

(*Read March* 14, 1870.)

January.—The barometer ranged from 30.455 inches on the 1st to 29.119 on the 6th; a difference of 1.336 inch. The mean of the month being 29.7182 inches after making corrections for temperature, altitude of 60 feet and force of vapour.

The thermometer ranged from 51 on the 10th to 9 below zero on the 23rd which was the coldest night, and the mean for the day being 4°; the temperature at noon being only 1 degree. The mean for the month was 19.65, and the extreme range 60°.

The relative humidity had a mean per centage of 78.7 saturation, or 100 on the 16th, and 61 on the 28th.

The force of vapour had a mean of 2.7319 millimetres or .1075 inch. The least being 0.65 milli. on the 23rd, (coldest day) and the greatest 8.68 milli. on the 10th, or the hottest day.

The anemometer made 636,500 revolutions in the month, or an average of 17.08 miles an hour. There was a calm for 8 hours on the 3rd, when the anemometer did not revolve. There were high winds on the 6, 7, 10, 17, 20, 21. The strongest on the 20th registered 35360 revolutions, or 707 miles for the 24 hours.

There were 3 days of rain and 8 of snow measuring 12 inches, included when melted in 3.610 inches of rain fall. 3 nights below zero; 29 nights of frost giving 526 degrees of frost; 5 nights of rimy frost; 2 days of silver thaw, one of hail. No fog, rainbow, or thunder and lightning. One night of aurora; 2 halos round sun, 1 halo round moon; 2 coronæ round moon.

The wind made two revolutions back or against the sun; and the prevailing winds were from S. to W. 10; W. to N. 12; N. to E. 7; E. to S. 2.

First ice made on the 23rd in the bay outside the bar. The mean temperature was 4 degrees milder than in 1868, and one inch less rain fell.

February.—The barometer ranged from 30.559 inches on the 26th to 28.886 inches on the 4th; a difference of 1.663 inch. The mean of the month being 29.6804 inches, after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 1 below zero, on the 15th, to 40 degrees on the 27th. The 15th was the coldest day having a mean of 4 degrees; the temperature at noon being 9. The mean for the month was 23.50 degrees, and the extreme range 41 degrees.

The relative humidity had a mean per centage of 72. Greatest amount of saturation 92 on the 16th. Least amount of moisture 45 per cent. on the 4th.

The force of vapour had a mean of 3.5675 millimetres equal to .1406 inch. The least being 1.38 milli. on the 3rd, and the greatest 6.19 milli. on the 16th, with sleet from E. S. E.

The anemometer made 559320 revolutions in the month, or an average of 16.64 miles an hour. There were high winds on 1, 2, 3, 12, 17, 19, 27. The strongest on the 27th registered 38,700 or 774 miles in the 24 hours. In the forenoon it averaged 40 miles an hour.

There were 3 days of rain and 9 of snow, measuring 22 inches included when melted in the 5.820 inches of rain fall. One night below zero; 27 nights of frost, giving 374 degrees of frost. 4 nights of rimy frost, 2 of hail, 2 of silver thaw, one day of fog. No lightning or rainbows, 5 times northern lights, 2, 3, 10, 14, 18. 3 halos round the sun, and 2 round the moon.

The wind made 3 turns with the sun, and 2 against the sun. The prevailing winds were S. to W. 7, W. to N. 9, N. to E. 7, E. to S. 5. Heard a greybird singing on the 18th.

March.—The barometer ranged from 30.505 inches on the 23rd to 29.004 inches on the 22nd; a difference of 1.401 inch. The mean of the month being 29.7547 inches, after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 46° on the 11th to 4° below zero on the 6th, which was the coldest day of the month, the mean being 4.5 degrees, the temperature at noon being 13 degrees. The mean for the month was 23.60 degrees, and the extreme range 50 degrees.

The relative humidity had a mean per centage of 68. Greatest amount of saturation 88 on the 27th. Least amount of moisture 46 per cent. on the 22nd.

The force of vapour had a mean of 3.9680 millimetres, equal to .1561 inch. The least being 1.56 milli. on the 6th, the coldest day; the greatest being 7.13 milli. on the 11th, when a gale of wind was blowing from the north.

The anemometer made 711,000 revolutions in the month, or an average of 19.11 miles an hour. There were gales on 1, 5, 7, 10, 11, 19, 20, 21, 23, 27. The strongest on the 1st registered 1257 miles in the 24 hours.

There were 2 days of rain and 10 of snow measuring 26¼ inches included when melted in the 6.005 inches of rain. Two nights below zero; every night frost, giving 507 degrees of frost. 7 nights of rimy frost, a silver thaw on 13th, one of hail, no fog, lightning or rainbows. 5 times northern lights on 8, 9, 13, 17 and 19; and 6 halos round the sun.

The wind made two revolutions with the sun, and the prevailing winds were from S. to W. 7, W. to N. 14, N. to E. 5, and E. to S. 5.

Wild geese at Lingan on 15th; drift ice jambed on shore on the 19th.

April.—The barometer ranged from 30.181 inches on the 24th, to 29.305 inches on the 26th, a difference of .876 inch. The mean of the month being 29.5288 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 22 degrees on the 12th to 62 degrees on the 21st. The 14th was the coldest day, having a mean of 28 degrees. The hottest days were 21st and 22nd, having a mean of 46.5 degrees. The extreme range was 40 degrees from 22 to 62.

The relative humidity had a mean per centage of 70.3. Greatest amount of saturation 92 on the 1st. Least amount of moisture 32 on the 28th.

The force of vapour had a mean 5.7716 millimetres, equal to .2273 inch. The least being 2.71 milli. on the 28th, and the greatest 10.08 milli. on the 21st at noon, followed by rain at 5 p. m. from S. S. W.

The anemometer made 637,800 revolutions in the month, or an average of 17-72 miles an hour. There were high winds on 10, 14, 15, 21 and 23. The strongest on the 15th registered 61,600 or 1026 miles in the 24 hours, or 50 miles an hour.

There were 5 days of rain and 8 days of snow, measuring 19 inches included when melted in the 4.420 inches of rain fall. 29 nights of frost, giving 103 degrees of frost; 2 nights of rimy frost; one of hail on the 29th; one of silver thaw; 8 times of fog. No lightning or rainbows; 4 times auroras, 2, 11, 12, 16; two halos round the sun.

The wind made 3 turns with the sun, and one turn against the sun. The prevailing winds from S. to W. 6, W. to N. 11, N. to E. 10 and E. to S. 3. First robin seen on the 8th. Frog piped on the 19th. 22nd, first vessel arrived at Port Caledonia. On 27th drift ice passing south.

May.—The barometer ranged from 30.059 inches on the 31st, to 29.059 inches on the 20th; a difference of 1 inch. The mean of the month being 29.5377 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 25 degrees on the 1st, to 63 degrees on the 24th. The mean being 40.15 degrees. The coldest day was the 1st, with a mean of 31.5 degrees, and the extreme range was 38 degrees.

The relative humidity had a mean per centage of 69.6. Greatest amount of saturation 91, on the 18th. Least amount of moisture 30 per cent. on the 30th.

The force of vapour had a mean of 5.7167 millimetres, equal to .2273 inch. The least being 2.70 milli. on the 1st, after the coldest night. The greatest being 9.58 milli. on the 26th.

The anemometer made 632,320 revolutions in the month, or an average of 17 miles an hour. There were high winds on the 1st, 2nd, 3rd and 27th; the strongest, 694 miles in the 24 hours on the 27th.

There were 13 days of rain (of which two were snowy, measuring one inch) measuring 7.400 inches. 11 nights of frost, giving 25 degrees of frost. Two nights of rimy frost, one of hail on the 10th; 15 times fog; no lightning or rainbows. 4 auroras on the 8th, in a long waving curtain, 10th, 13th and 29th. 6 halos round the sun; one round the moon at 10 p. m. on the 19th.

The wind made 4 revolutions with the sun, and the prevailing winds were S. to W. 4, W. to N. 10, N. to E. 11, and E. to S. 6. Drift ice jambed into the bay on the 2nd; gathered mayflowers in bloom on the 2nd. White coltsfoot, (Nardosmia palmata,) on the 9th. Dandelion on the 28th, (Leontodon autumnalia.) Cod and herrings caught on the 8th. Saw butterfly on the 11th, and heard "yellow-leg" plover. On 12th saw a spotted brown snake 2 feet long. Swallows on 23rd. 25th, Gaspereau running up Big Glace Bay brook.

June.—The barometer ranged from 29.630 on the 16th to 30.115 inches on the 23rd; a difference of .485 inch. The mean of the month being 29.5950 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 76 degrees on the 6th, to 38 degrees on the 10th, which was the coldest day; being 45 degrees at noon, and a mean of 41.5 degrees. The 6th was the hottest day, having a mean of 65 degrees. The mean for the month was 54.3 degrees, and the extreme range was 38 degrees.

The relative humidity had a mean per centage of 64.9 Greatest amount of saturation 90 on the 23rd. Least amount of moisture 37 on the 28th.

The force of vapour had a mean of 8.9264 millimetres, equal to .3512 inch. The least being 5.42 milli. on the 12th, the greatest being 14.98 milli. on the 25th; the thermometer being 22.8 cen. at 8 a. m.

The anemometer made 577,640 revolutions in the month, or an average of 16 miles an hour. There were high winds on the 9th, 10th, 14th and 15th, the strongest wind was on the 9th, registering 771 miles in the 24 hours.

There was not any snow or frost; eleven days of rain measuring 3.330 inches. 4 times of fog on 1st, 5th, 6th and 23rd. Lightning and thunder on the 23rd and 29th. Auroras on the 12th and 18th. 3 halos round sun.

The wind made 6 revolutions with the sun, and the prevailing winds were from S. to W. 14, W. to N. 7, N. to E. 4, E. to S. 5. Heard mosquito hawks on the 3rd. Saw swallow-tailed butterfly on the 15th.

July.—The barometer ranged from 30.087 inches on the 20th, to 29.230 inches on the 1st; a difference of .857 inch. The mean of the month being 29.4164 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 43 degrees on the 6th, to 86 degrees on the 29th. The mean being 59.80 degrees. The coldest day was the 1st, with a mean of 47.5 degrees. The hottest day was the 29th with a mean of 84 degrees, and the extreme range was 43 degrees.

The relative humidity had a mean per centage of 65.9. Greatest amount of saturation 84 on the 4th. Least amount of moisture 44 on the 14th.

The force of vapour had a mean of 11.5191 millimetres, equal to .4535 inch. The least being 7.49 milli. on the 2nd, after the coldest morning. The greatest being 17.31 milli. on the 28th, with the thermometer standing at 82 degrees.

The anemometer made 539,570 revolutions in the month, or an average of 13.67 miles an hour. There was a gale on the night of the 1st with hail, reported by the pilots; also on the 11th and 16th. The strongest was on the 11th, registering 652 miles in the 24 hours.

There were 8 days of rain, measuring 6.400 inches. No frost or snow. 2 days it hailed. Fog on the 4th and 9th. Lightning and thunder on the 7th, 16th and 23rd. A rainbow on the 7th. Faint aurora on the 18th.

The wind made two revolutions with the sun; and the prevailing winds were S. to W. 18, W. to N. 4, N. to E. 6, E. to S. 3. Fireflies seen on the 3rd.

August.—The barometer ranged from 30.245, on the 1st, to 29.501 inches on the 27th; a difference of .744 inch. The mean of the month being 29.5107 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 78 degrees on the 5th to 42 degrees on the 18th. The mean being 61.33 degrees. The coldest day was the 20th with a mean of 53 degrees; the hottest day was the 5th with a mean of 69 degrees. The extreme range was 36 degrees.

The relative humidity had a mean per centage of 67.65. Greatest amount of saturation 87 on the 6th. Least amount of moisture 48 on the 13th.

The force of vapour had a mean of 10.659 millimetres, equal to .4197 inch. The least being 7.35 milli. on the 24th, being the coldest day at noon. The greatest being 14.60 milli. on the 5th, or the hottest day.

The anemometer made 472,540 revolutions in the month, or an average of 12.7 miles an hour. There were not any high winds during this month, 542 miles in the 24 hours on the 3rd being the highest registered.

There were 11 days of rain, measuring 2.725 inches. No frost, snow, hail, or fog. Lightning and thunder, 5 to 6 p. m., on the 31st. A triple rainbow at 6 p. m. on the 27th. Also rainbow 3 p. m. on the 31st. Auroras on the 1st, 5th, 6th, 8th and 28th. One halo round the sun. One corona round the moon on the 18th.

The wind made 4 revolutions with the sun, the prevailing winds S. to W. 9, W. to N. 8, N. to E. 5, E. to S. 9.

Flock of black ducks on lake, 3rd. Eclipse of sun, not well seen, at 6 p. m. on the 7th. Curlew seen on the 24th.

September.—The barometer ranged from 30.343 on the 18th, to 29.683 inches on the 20th; a difference of .660 inch. The mean of the month 29.6183 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 78 degrees on the 8th to 38 degrees on the 23rd. The mean being 56.95 degrees. The hottest day was the 9th, the mean being 73 degrees, (the night not falling below 69 and the day 77 degrees.) The coldest day was the 29th, with a mean of 45.5 degrees. The extreme range being 40 degrees.

The relative humidity had a mean per centage of 71.2. Greatest amount of saturation 92 on the 21st. Least amount of moisture 44 on the 6th.

The force of vapour had a mean of 10.481 millimetres, equal to .4130 inch. The least being 6.09 milli. on the 22nd, or the morning before the coldest day. The greatest being 18.18 milli. on the 9th, the thermometer being at 77 degrees.

The anemometer made 562,730 revolutions in the month, or an average of 15.63 miles an hour. There was a gale on the nights of the 2nd, 16th, 20th, 21st and 28th. The strongest was on the 20th, or 820 miles in the 24 hours.

There were 8 days of rain measuring 2.870 inches. Three nights of hoar frost, on the 19th, 23rd and 29th. No snow, hail, lightning or thunder. Fog on the mornings of the 9th and 27th. Auroras on the 1st, 3rd, 5th, 9th, 11th, 25th and 28th. Halo round the sun on 13th.

The wind made 5 revolutions with the sun, and none against it; the prevailing winds S. to W. 14, W. to N. 4, N. to E. 9, E. to S. 3. Wild geese in the Bay on the 18th.

Coliseum, Boston, blown down on the 7th when we had only a moderate breeze, 226 miles in the 24 hours.

October.—The barometer ranged from 30.256 inches on the 2nd to 28.927 inches on the 27th; a difference of 1.329 inch. The mean of the month being 29.6430 inches, after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 75 degrees on the 4th to 22 degrees on the 29th. The mean being 48.55 degrees. The coldest day was the 29th, with a mean of 29.5 degrees. The hottest day was the 4th, with a mean of 66 degrees, and the extreme range was 53 degrees.

The relative humidity had a mean per centage of 75.5. Greatest amount of saturation on the 16th and 19th, being 91. Least amount of moisture 47 on the 1st.

The force of vapour had a mean of 8.2809 millimetres, equal to .3260 inch. The least being 4.18 milli. on the 29th, or the coldest morning. The greatest being 14.24 milli. on the 5th, when the day had a mean temperature of 63.5 degrees.

The anemometer made 678,320 revolutions in the month, or an average of 18.04 miles an hour. There was gale began at 7 p. m. on the 4th, lasted two days from S. W. and S.; on the 11th, 16th, 17th, 24th and 27th from E. N. E. to N. and N. W.; the guage registered 66 miles an hour for 15 hours, and a total of 1360 miles for the 24 hours; this was the highest wind marked for the whole year.

There were 14 days of rain and snow mixed together, measuring 3 inches of snow, melting as it fell, and 7.220 inches of rain and melted snow. 9 nights of frost, and 15 degrees below 32°; 5 nights of rimy frost; 3 fogs on 13th, 16th and 17th. No hail, or lightning and thunder. Rainbows on the 5th, 7th and 28th: the latter might be called a *Snow-bow*, for it had not the prismatic colours, and it appeared double the width of ordinary rainbows. Auroras on the 2nd, 3rd, 5th and 9th.

The wind made 3 revolutions with the sun, and one against the sun on the 13th. The principal winds were S. to W. 11, W. to N. 8, N. to E. 4, and E. to S. 8. Earthquake felt at 6 a. m. at Arichat, Halifax, Windsor, State of Maine. San Francisco, on the 13th.

November.—The barometer ranged from 29.156 inches on the 8th to 30.539 inches on the 20th; a difference of 1.383 inch. The mean of the month being 29.6878 inches after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 53 degrees on the 6th to 22 degrees on the 20th. The mean being 37.45 degrees. The warmest day was the 6th, with a mean of 49.5 degrees; the coldest day was the 20th, with a mean of 31 degrees, and the extreme range was 31 degrees.

The relative humidity had a mean per centage of 77.74. Greatest amount of saturation 93 on the 28th. Least amount of moisture 62 on the 10th and 12th.

The force of vapour had a mean of 5.8395 millimetres, equal to .2299 inch. The greatest being 10.19 milli. on the 22nd, and the least being, on the 30th, 2.91 millimetres, or the coldest day at 8 a. m.

The anemometer made 635,180 revolutions in the month, or an average of 17.64 miles an hour. There was a gale on the 15th, 17th, 20th, 21st, 28th and 29th. Each of these gales lasted about two days; the heaviest was on the 21st, equal to 1065 miles in the

24 hours, from S. and S. E. The aneroid metallique marked 7800 millimetres, or 30.709 inches on the 20th, (12 hours before the gale.)

There were 12 days of rain and 3 of snow (depth 1 inch) which measured 5.065 inches. 22 nights of frost, and 47 degrees of frost; 3 fogs on 5th, 21st and 22nd. One aurora on the 8th. Halo round sun on 24th and 30th.

The wind made 3 revolutions with the sun, and 2 against the sun. The principal winds were S. to W. 11, W. to N. 9, N. to E. 7, and E. to S. 3.

December.—The barometer ranged from 29.260 inches on the 1st to 30.590 inches on the 11th; a difference of 1.330 inch. The mean of the month was 29.8990 inches, after making corrections for temperature, altitude and force of vapour.

The thermometer ranged from 55 degrees on the 1st to 15 degrees on the 25th. The mean being 30 degrees. The coldest day was the 4th, with a mean of 20 degrees; the hottest day was the 29th, with a mean of 47 degrees, and the extreme range was 40 degrees.

The relative humidity had a pei centage of 76, and greatest amount of saturation 96 on the 23rd. Least amount of moisture 44 on the 25th.

The force of vapour had a mean of 4.7245 millimetres, equal to .1860 inch. The least being 194 milli. on the 4th, and the greatest being 9.61 milli. on the 1st, which was the warmest day at noon.

The anemometer made 713,210 revolutions in the month, or an average of 19.17 miles an hour, being the most windy month in the year, and a little in excess of March. There were gales on the 1st, 3rd, 7th, 14th, 15th, 18th, 19th. The greatest gale was on the 3rd, making 1010 miles in the 24 hours. On 19th gale marked 59 miles an hour, from 9 a. m. to 1 p. m.

There were 15 days of rain, including 75 inches of snow on 6 days, measuring 5.655 inches. 25 nights of frost, and 197 degrees of frost. 6 nights of rimy frost. 4 fogs on 7th, 27th, 28th and 29th. Rainbows on the 18th until 11 a. m. One halo round sun, and 2 halos round moon. No auroras observed.

The wind made 1 revolution with the sun, and 1 revolution against the sun. The principal winds were S. to W. 13, W. to N. 8, N. to E. 6, E. to S. 4.

1869.	Barometer. Mean corrected to 32°.	Correc. for Vapor & 60 ft. above Sea	Highest corrected.		Lowest corrected.		Mean.	Mean Night.	Mean Day.
January	29.7657	29.7182	30.455	1st	29.210	20th	19.65	14.3	25.
February.......	29.7610	29.6804	30.559	26th	28.886	4th	23.50	18.2	28.
March	29.8508	29.7547	30.505	23rd	29.004	2nd	23.60	16.0	31.
April............	29.6961	29.5288	30.181	24th	29.305	26th	34.32	29.3	39.
May.............	29.6928	29.5377	30.059	31st	29.059	20th	40.15	35.0	45.
June......	29.8862	29.5950	30.115	23rd	29.630	16th	54.30	45.9	62.
July	29.8100	29.4164	30.087	20th	29.230	1st	59.80	50.0	69.
August	29.8704	29.5107	30.245	1st	29.501	27th	61.33	53.3	69.3
September	29.9713	29.6183	30.343	18th	29.683	20th	56.95	50.7	63.
October.........	29.9090	29.6430	30.256	2nd	28.927	27th	48.55	43.3	53.
November	29.8577	29.6878	30.539	20th	29.156	8th	37.45	33.6	41.
December	30.0250	29.8990	30.590	11th	29.260	1st	30.00	23.6	36.
Mean..........	29.8413	29.6325	....	......	......	......	40.80	34.43	47.1
Extreme	....	....	30.590	Dec. 11.	28.886	Feb. 4.	....	....	....

COMPARED WITH THE ABOVE.

1867.									
Mean........	29.8524	29.6704	......	....	......	....	40.06	34.17	45.9
Extreme	....	....	30.768	Feb. 11	28.676	Sept. 30	...	.....	....
1868.									
Mean	29.8854	29.6924	......	....	......	....	39.29	33.64	44.8
Extreme	....	....	30.611	Mar. 6	28.809	Feb. 6	...	.....	....

CLIMATE OF ALBION MINES

Ten Years.	29.7137	... ...	30.757	....	28.505	....	41.97	33.11	50.91

METEOROLOGICAL REGISTER, CALEDONIA MINE, LITTLE GLACE BAY, CAPE BRETON, 60FT ABOVE SEA, LAT. 46°, 12 NORTH, LON. 59° 57′ WEST.

1869.	Barometer. Mean corrected to 32°.	Barometer. Correc. for Vapor & 60 ft. above Sea	Barometer. Highest corrected.		Barometer. Lowest corrected.		Thermometer. Mean.	Thermometer. Mean Night.	Thermometer. Mean Day.	Coldest. Night.		Coldest. Day.		Hottest. Night.		Hottest. Day.		Force of Vapour in Inches.	Relative Humidity.	Force of Vapour in Millimetres.	Revolutions of Wind.	Miles per hour.
January	29.7657	29.7182	30.455	1st	29.210	20th	19.65	14.3	25.2	-9	23rd	1	23rd	46	10th	51	10th	.1075	78.7	2.7319	636500	17.08
February	29.7610	29.6804	30.559	26th	28.886	4th	23.50	18.2	28.8	-1	15th	9	15th	35	17th	40	27th	.1406	72.0	3.5675	559320	16.64
March	29.8508	29.7547	30.505	23rd	29.004	2nd	23.60	16.0	31.2	-4	6th	13	6th	32	28th	46	11th	.1561	68.0	3.9680	711000	19.11
April	29.6961	29.5288	30.181	24th	29.305	26th	34.32	29.3	39.3	22	12th	29	14th	41	22nd	62	21st	.2273	70.3	5.7716	637800	17.72
May	29.6928	29.5377	30.059	31st	29.059	20th	40.15	35.0	45.3	25	1st	36	3rd	48	12th	63	24th	.2251	69.6	5.7167	632320	17.00
June	29.8862	29.5950	30.115	23rd	29.630	16th	54.30	45.9	62.7	38	10th	45	10th	60	16th	76	6th	.3512	64.9	8.9264	577640	16.09
July	29.8100	29.4164	30.087	20th	29.230	1st	59.80	50.0	69.6	43	6th	49	1st	66	27th	86	29th	.4535	65.9	11.5191	539570	13.67
August	29.8704	29.5107	30.245	1st	29.501	27th	61.33	53.3	69.33	42	18th	56	24th	62	4th	78	5th	.4197	67.6	10.6591	472540	12.70
September	29.9713	29.6183	30.343	18th	29.683	20th	56.95	50.7	63.2	38	23rd	50	21st	69	9th	78	8th	.4130	71.2	10.4810	562730	15.63
October	29.9090	29.6430	30.256	2nd	28.927	27th	48.55	43.3	53.8	22	29th	36	28th	63	5th	75	4th	.3260	75.5	8.2809	677320	18.04
November	29.8577	29.6878	30.539	20th	29.156	8th	37.45	33.6	41.3	22	20th	34	12th	47	7th	53	6th	.2299	77.7	5.8395	635180	17.64
December	30.0250	29.8990	30.590	11th	29.260	1st	30.00	23.6	36.4	15	25th	21	4th	45	29th	55	1st	.1860	76.0	4.7245	713210	19.17
Mean	29.8413	29.6325	......	......	......	......	40.80	34.43	47.17	..	......	..	......	..	......	..	......	.2696	68.1	6.8488	612927	16.8
Extreme	....	....	30.590	Dec. 11.	28.886	Feb. 4.	......	......	......	-9	Jan. 23.	1	Jan. 23	69	Sep. 9th.	86	July 29th	.....	.....	..... or	7355130 147102	miles
Compared with the above.																						
1867. Mean	29.8524	29.6704	......	....	......	....	40.06	34.17	45.95	..	...	..	....	..	....	..	......	.2438	72.87	6.194	643534	17.6
Extreme	....	....	30.768	Feb. 11	28.676	Sept. 30	...	.....	.....	-10	Jan. 31	1	Dec. 31	67	Augt. 25	85	Augt. 8	.....	....	....	2722414 or 154448	..... miles
1868. Mean	29.8854	29.6924	......	....	......	....	39.29	33.64	44.84	..	..	..	....	..	....	..	... ..	.2454	74.30	6.233	675908	18.5
Extreme	....	....	30.611	Mar. 6	28.809	Feb. 6	... .	.....	.....	-13	Feb. 4	4	Feb. 22	66	July 2	89	July 5	.....	....	....	8110903 162218	... . miles
Climate of Albion Mines, Nova Scotia, Lat. 45° 34′ 30″ North, Lon. 62° 42′ West, 120 Feet above the Sea.																						
Ten Years.	29.7137	... ...	30.757	....	28.505	....	41.97	33.11	50.91	-22 23	1851 Jany. 7 1853 Jany. 13	..	....	..	....	98	1842 July 14	.....	....	....	....	.....

1869.	Rain. Inches.	Rain. Days.	Snow. Days.	Snow. Inches.	Nights of Frost.	Degrees of Frost.	Below Zero.	Rimy Frost.	Hail.	Silverthaw.	Fogs.	Light Thunder.	Rainbows.	North Lights.	Halo r'd Sun.	Halo r'd Moon.	Corona.	Wind. Turned With Sun.	Wind. Turned Against Sun.	True North. S. to W.	True North. W. to N.	True North. N. to E.	True North. E. to S.
January	3.610	11	8	12	29	526	3	5	1	2	..	..	..	1	2	1	2	......	2	10	12	7	2
February	5.820	12	8	22	27	374	1	4	2	2	1	..	..	5	3	2	..	3	2	7	9	7	5
March	6.005	12	10	$26\frac{1}{4}$	31	507	2	7	1	1	..	..	..	5	6	..	..	2	....	7	14	5	5
April	4.420	15	8	19	29	103	...	2	1	1	8	..	..	4	2	..	..	3	1	6	11	10	3
May	7.400	13	2	1	11	25	...	2	1	...	15	..	..	4	6	1	..	4	..	4	10	11	6
June	3.300	11	...	......	....	......	...	..	..	...	4	2	..	2	3	..	..	6	......	14	7	4	5
July	6.400	8	...	......	......	.....	...	..	2	...	2	2	1	1	..	..	..	2	....	18	4	6	3
August	2.725	11	...	......	......	......	...	..	..	..	..	1	2	5	1	..	1	4	....	9	8	5	9
September	2.870	8	...	......	3	0	...	3	..	...	2	..	..	7	1	..	..	5	....	14	4	9	3
October	7.220	14	3	3	9	15	...	5	...	...	3	..	3	4	..	..	..	3	1	11	8	4	8
November	5.065	12	3	1	22	47	...	3	...	...	3	..	..	1	2	..	..	3	2	11	9	7	3
December	5.655	9	6	$7\frac{1}{2}$	25	197	...	6	...	..	4	..	1	..	1	2	..	1	1	13	8	6	4
Mean	5.041			......	......	......	..	..	..	..	..	..	..	..	..	..	..	......	......	..	..	..	..
Extreme	60.490			$91\frac{3}{4}$	186	1794	6	37	8	6	41	6	7	39	27	6	3	36	9	124	104	81	56
		92	48																				
		140																					
Compared with the above.																							
1867. Mean	4.841	12	..	.	...	....	..	..	..	..	..	..	..	..	..	..	..	....	....	..	..	..	..
Extreme	58.090	147	52	125	172	2171	7	23	5	5	25	9	6	26	16	3	..	36	17	122	114	54	75
1868. Mean	4.975	$12\frac{1}{2}$	..	....	....	.	..	..	..	..	..	..	..	..	..	..	...	...	....	..	..	..	..
Extreme	59.750	152	65	$94\frac{1}{2}$	193	2486	15	18	6	3	28	12	6	35	23	7	2	35	5	129	107	76	54
Climate of Albion Mines, Nova Scotia.																							
Ten Years.	44.967	173	63	$111\frac{1}{2}$	189	2470	19	..	..	..	19	..	..	..	..	..	..	...	....	112	126	66	61

HENRY POOLE.

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

(*Read April*, 1870.)

Castor, *Zibethicus*, (Linn., Erxlebein, Pallas.)
Mus Zibethicus. (Gmelin, Shaw.)
Fiber, *Zibethicus.* (Cuvier, Richardson, Dekay, Baird, Audubon, Bachman.)
Musk Beaver. (Pennant.)
Ondrata.
Mussacus. (Capt. John Smith's Virginia.)

THE MUSKRAT.

FROM this small selection of synonyms by which our familiar muskrat has been honoured, it will appear that Linnæus, and the older naturalists, classed him in genus with the beaver, and from his appearance, his habits, and the domes which he constructs, we may well pardon them, especially as at that time the raccoon and the bear were congeners. He was next degraded back to the murinæ or mice, until Fred. Cuvier formed him into a genus composed of himself alone, but immediately following the beaver. The genus *Fiber*. Here he now remains, but the later American naturalists, in removing him from the *Castorinæ* and placing him after the *Arvicolinæ*, (a sub-family of mice,) have returned somewhat to the views of Gmelin, Bodaet, Shaw, and other naturalists immediately succeeding Linnæus. The specific, *Zibethicus*, still remains to him. When we study his figure we distinctly see that in form of skull, in teeth and tail, he so widely diverges from the beaver that it is impossible to class them together, and that in all these divergences he approaches the mice. On the other hand his constructive habits ally him closely with the beaver. We will have to leave him in, to quote Dr. Dawson, of Montreal, "the present chaos of synonyms afflicting modern zoology."

From a medium sized one before me obtained by my son, at Prospect, Nova Scotia, April, 1870, I got the following measurements.

Length of body	$12\frac{1}{2}$	inches.
Length of tail	9	inches.
Of hind leg from heel to end of toe claw	$3\frac{1}{8}$	inches.
From tip of nose to eye	$1\frac{1}{2}$	inch.
From nose to insertion of fore paw	4	inches.

In shape he is round and lumpy, narrow in front, and swelling out wider towards the tail, or rather pear-shaped; the head being the stalk end. The head is small, and nose rather blunt, upper teeth projecting over the under and showing outside the lip; the lower lip also not covering the under teeth. The eye is small near the nose and not expressive. The ear very small, round, and hidden in the fur. There are six horizontal rows of whiskers on either side of the mouth, and a series under the chin and above each eye. The fore feet are very short, the carpal, or wrist bones only projecting outside the hair. There is no thumb, but a flat rudimentary nail. The two middle fingers are much longer than the first and fourth, whose nails reach a little beyond the middle fingers without the claws. There are five tubercles upon the palm, two at the base with a deep groove, and three others at the roots of the toes. The nails are long, gouged out on the inner surface, sharp, and of a rose pink colour when recent. Although the fore foot is placed very forward, still it is so short that the mouth cannot be reached until the head is bent downwards. The palms are naked, but the upper parts covered by fine hairs.

The hind feet are proportionately larger than the fore, with five toes, of which the inner is the shortest, the next longest the outer, the next the second inner, while the two middle are nearly of a co-length, and one-third of an inch longer than the second inner. They are all armed with nails of the same description and colour as the fore feet. The soles are black, naked and having one large callosity at the base, and three smaller tubercles at the roots of the toes. The toes are all beautifully fringed on both sides of their entire length, also the sides of the entire foot to the heel with rows of fine stiff hair ending in a tuft. The whole foot appears also as if it had been twisted, or that its sole presented a plane oblique to the plane of the body, and not at right angles with it. The tail is naked apparently, but when minutely examined, covered with small hexagonal scales, overlaid by short hairs. It is roundish at first, becoming suddenly flattened as it approaches the middle, and ending in a fine point, and appearing somewhat nickle-shaped in life. The teeth are stained yellowish red, as to the incisors, and there are two incisors and six molars to either jaw, that is one incisor and three molars to a side. In looking into the mouth, there is a small valve of mucous membrane dropping down from the palate, and a second one arising from the lower jaws to meet it, and immediately behind them, farther down the mouth a hairy tuft; thus forming a complete valve which allows the muskrat to open his mouth beneath the water, without swallowing it. There is also a small tubercle upon the nostril which may serve to close it under water. The fur covering him is of two kinds, a soft, woolly, interior fur, and long shining black hairs on the outside. The basal colour of both is blueish ash. Beneath, on the belly, the fur is light reddish brown, the under strata where it is occasionally seen, toning down to ash. Beneath the chin light ash, which colour sometimes runs down the mesian line. On the forehead, back, sides of face, and half way down the sides the long shining hairs of dark sepia brown make it almost black, did not the under colour, shewing through at places, tone it off to brown. This fur in season is shining and glossy to a degree, and very beautiful and lustrous. Its cheapness alone preventing it becoming fashionable wear.

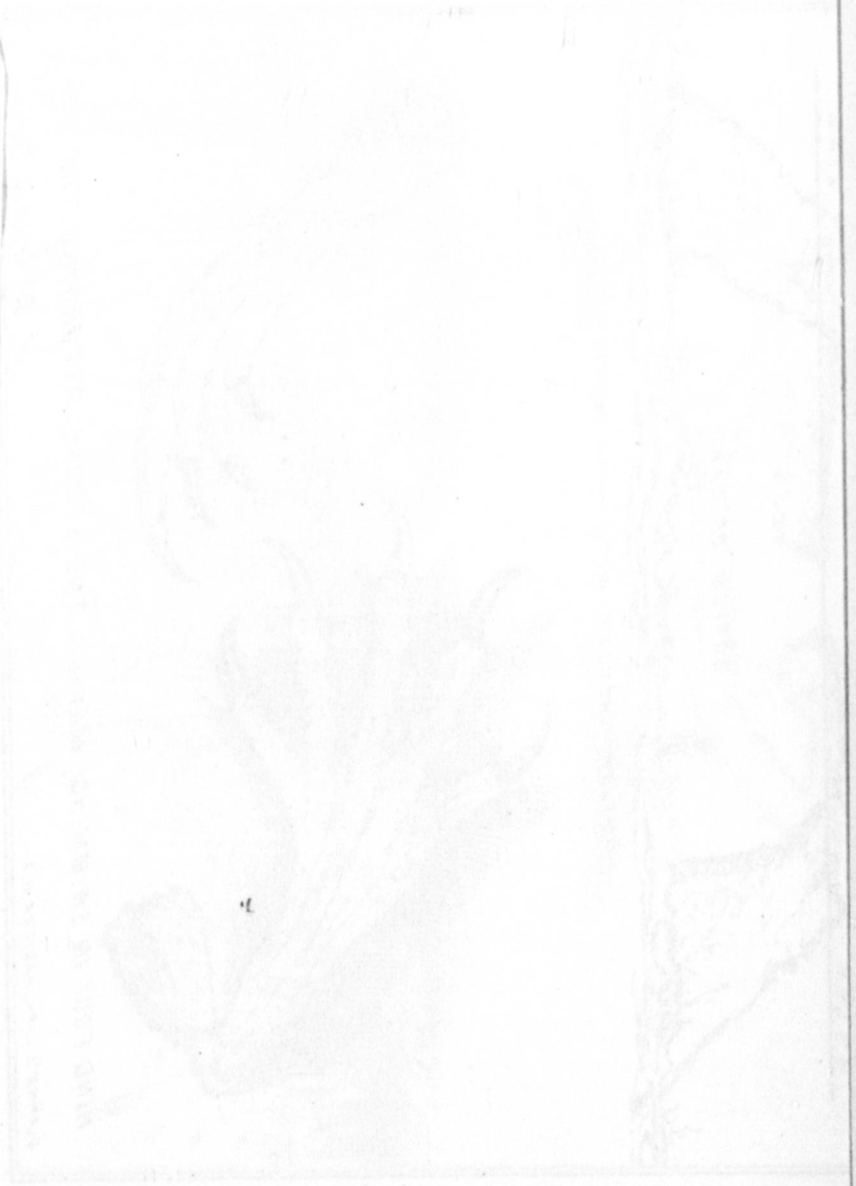
You will now from my somewhat tedious description and from my drawings get a good idea of this large rat, but still small animal, with which our Province abounds,—his thick pyramidal figure, very short, and very far forward set on fore legs, peculiar tail and hind legs. Besides the peculiarity of his valvular mouth, which I have already mentioned, and which is well described by Baird, I would call to your notice the very peculiar hind leg. In swimming, after the stroke the leg and foot are brought forward, with a fine oblique edge cutting the water, the fringes on the toes lying close to the toes, like the feather edge of an oar; but in delivering the stroke each toe is spread wide, and the fringes of all the toes, and of the leg, floating off at right angles with each toe interlace and form a very broad web, and capable of displacing a great volume of water. Thus a temporary web is formed and dissolved at each stroke. This fact is not noticed by any writer before, and must be considered a suggestion of my own. I have said he abounds in our Province, in the neighbourhood of our cities, as well as in our most secluded lake basins. Unlike other wild creatures he shuns not the approach of man on his improvements. At Steel's pond, where for many years there was a house, and at Freshwater, they very lately might be seen. I have also repeatedly seen them in Griffin's pond, where I have noticed them swimming in graceful circles with their tails extended behind them, and round head just appearing above the water, with a heap of fluffy fur floating as their back breaks the surface. In diving the head is arched suddenly, the fluffy back disappears, and the tail whips the water with a loud splash. This is the splash which often startles the patient angler on some far woodland darkened stream,—so patient and motionless that the wary muskrat has ventured on his gambols before him. The night is his special time for seeking his food or his pastime, as well as for repairing his houses or making his holes. In swimming, I should think from his construction, his fore paws are laid close to his breast, like a frog, and that he propels himself like a duck by alternately using either leg. There is often an appearance of sport or play in his motions. At early eve of a summer day, the surface of a small lake seems constantly broken up by their ceaseless gambols; pursuing each other round and round, stopping to bite off a green rush, diving or throwing themselves entirely on one side, and so floating luxuriously along. In this position they must of necessity use but one leg. Presently some one more aspiring than his neighbour will quickly wriggle himself to the top of some rotten water-sodden stake, snuff about a moment, and then take as scientific a header as the biggest old villain of a bull-frog, on the whole water. As regards food he is a vegetable eater, eating the bullrushes, the various water carixes, the roots of the arrow-head, water lilly, iris and sweet flag, and even, according to some authors, the root of the terrible "arum tryphillum," or Indian turnip, of which too, it is said, the bear is fond. Heaven help them, if their mucous membranes are like ours! He comes afoot also into the fields and eats the imported timothy in preference to the native red top and blue joint, though nibbling at all. He cuts off the young wheat, and sprawls over and tangles up more than he eats. The mouths of his holes are very frequently literally paved with the shells of fresh water clams or unios. Audubon, to test them, put sea muscles and unios into the box in which he kept some domesticated. They immediately showed their fondness for them by taking them between their fore paws—like rats or squirrels—says the great naturalist; but we must beg his pardon, as well as Sir Edwin Landseer's, for rats and squirrels, at least American ones, hold everything with the backs of their paws, whilst our little animal holds things in its palms. However, the speedy disappearance of the flesh and empty shells proved him a flesh eater. A young sportsman watching ducks, up stream, on one of our pleasant streamlets, saw a muskrat coming down stream, pushing before her a raft composed of green bullrushes, and well packed. On my suggesting that she was building her nest, "Oh, it is only summer time, they don't build till fall, she is gathering green food for her little ones." To his shame, be it spoken, the toiling mother was too provocative, and the ready gun covered her, but only to rake with his shot the water where she swam, and scatter the green raft broad over the whirling waters. Her quick eye caught the flash, though it was a percussion gun, in time to evade the charge.

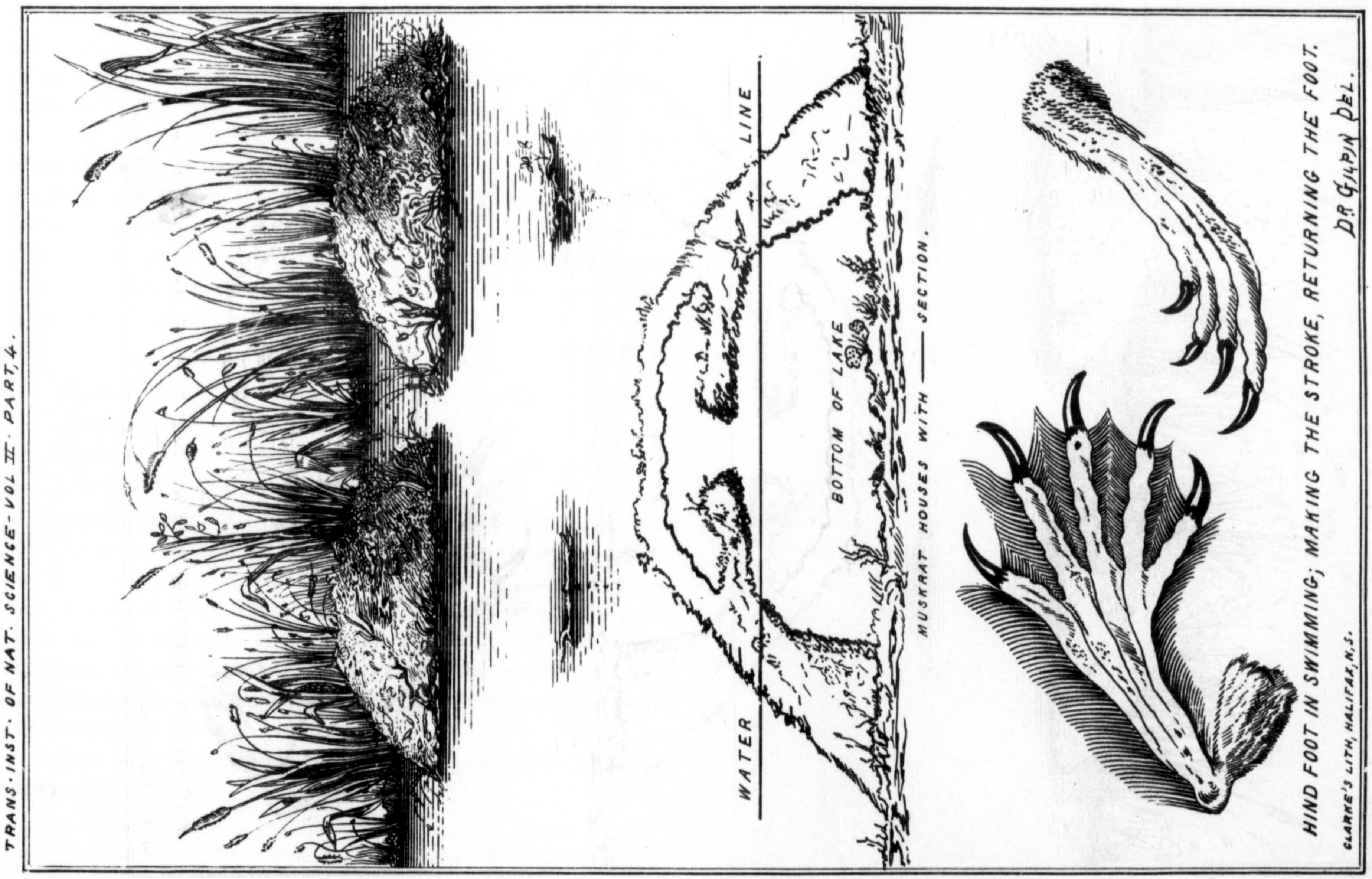
Towards the fall the muskrats, or at least a portion of them, build houses. It is singular that whilst all have burrowing holes, only a portion construct houses. Allen's River, near Annapolis, running between high clayey banks or artificial dykes abounds with them, yet I never saw a house within twenty miles; whilst at Windslow's lake, near Digby, at least fifteen can be counted within a few acres. Their burrows, according to Audubon, have three or four entrances below the water, all converging in an upward slant to a large hall from which other passages lead inward. The hall is lined with grass, and often filled with sticks, roots and other rubbish. The one he opened was also filled with the stalks of green maize which the rats had plundered from a neighbouring farmer.

The following description of a house or nest was sent me by my son: "There were about twelve nests on Windslow's lake, near Digby. The one I opened was about twenty yards from the shore, and on striking it with a stick I heard the rat leave the upper part, and dive beneath the water with a muffled sound. The depth of water about the nest was two feet three inches. The height of house above water one foot seven inches. The circumference at the water's edge about twelve feet or four feet diameter, but it spread out very rapidly beneath the water. I pulled it all to pieces. The upper room was about six inches below the top, and made of soft dry hay; the house being water tight. The materials of the whole house were flags, rushes, grass, sticks and hay. There were no air holes, but the rats may easily breathe through the hay, as the top is very thin and dented in a little or concave. Had I stepped upon it I should have put my foot through it. Though I kicked it all to pieces the rats will have it rebuilt before morning. On looking down through the nest into the water below, it was all filled with floating sticks and rushes." Thus we have it, a hollow dome, built from the bottom of the lake and standing about two feet above the water, with a shelf or gallery running round about six inches from the top and a foot from the surface of the lake, leaving a large central hole down which he dives and up which he crawls in going from and returning home. It is singular none of the systematic writers mentions air holes either to the nests or to the burrows, though the burrows must have been begun from the land sides, and pushed towards the water; as it would be impossible for the rat to burrow outside beneath the water, and when the lakes are frozen he must remain in his nest for weeks. He no doubt breathes through the loose material as the beaver must also do. The neighbours about Windslow's lake assert that many during winter burrow beneath the barns and hog-pens, some hundred yards or more from the water; and Mr. Anderson, at Port Piswick, showed me a hole beneath his saw mill in which they burrowed, coming up the mill race. He also told me that a freshet one year covered their nests, and that a large colony of them sought a hay-rick and burrowed into it. It must have been a magnificent dome for them. Lord founds a new species on those facts—the burrowers and the builders, but it cannot hold with ours, as many do both. Still I think the matter needs further research. I surprised one once heaping mud in circles on the ice, in order, as writers say, to rot the ice, and give him breathing holes. This was in New England, and he could easily manage during the soft warm short winter of the Southern Sea coast, beginning after Christmas and ending in early February, to keep his holes open, but in our Province where winter reigns from November till April, and where the two feet water of Windslow's lake is frozen solid, with perhaps a foot of snow ice upon its surface, he can never keep open water. I believe the truth is that, with the beaver, those who resort to their houses hybernate in the severe season of our northern climate. They never breed in their houses but prefer their burrows. In our Province they breed but once a year, having from four to six at a litter. I think it must be a clerical error by which Richardson states them to breed several times a year. The season is too short. In autumn the mother rat is not seldom seen quite afield with four or five little ones after her.

From eight to ten thousand skins are exported annually. The backs serve for muffs either natural or dyed, and were it not for their cheapness their great beauty would have made them fashionable wear in their native lustre. The belly parts plucked, dyed and pressed are so good an imitation of fur seal, that only dealers can detect the difference. The public have long ago accepted it as the genuine article, but I must not betray the secrets of trade.

TRANS· INST· OF NAT· SCIENCE-VOL II· PART, 4.





MUSKRAT HOUSES WITH —— SECTION.

HIND FOOT IN SWIMMING; MAKING THE STROKE, RETURNING THE FOOT.

This rat inhabits the whole North American continent, westward to the Pacific and southward to Carolina, and so far I believe with the beaver stands alone as a house building mammal. As I before stated, he does not retire from man and his works, but rather increases than otherwise near cities. He is not so sedulously trapped there as in the forest lakes, has fewer enemies, and finding his security in the very publicity of his haunts—he wears the freedom of the city with a charming grace.

More appropriate though to the sluggish sphagnum bordered lakelet, are his cunning circlets and splashy dives; in more accord with the bullrush and its feathery tops are his weather brown domes nestling among their reedy forests, like the lake houses of pre-historic man.

The Canada Porcupine.

Hystrix, dorsatus. (Linn., Erxlebein, Gmelin.)
Erethison, Dorsatus. (F. Cuvier.)
Hystrix, pilosa. (Catesby, Richardson.)
Canada porcupine. (Pennant.)

From these few synonyms it will be seen that this singular animal was first classed by Linnæus in the genus *Hystrix*, containing the European porcupine; in which genus it remained about sixty years, till Fred. Cuvier formed the genus *Erethison* especially for it; although Audubon and Richardson adhered to the old genus, the latter also, after Catesby, using the specific "*pilosa*," yet naturalists have in general admitted Cuvier's reasons to be sound and retained his genus.

A very large specimen examined at Staudigl's saloon, Halifax, measured:—

Total length	25	inches.
Length of tail	8	inches.
Length of hind paw to tip of nail	3½	inches.
Length of spines	3	inches.

This was a very large one, and usually I have noticed they vary much in size. The general colour was black, though a few long coarse hairs, black tipped with white, gave it a greyish hoary appearance. It was covered with spines, from the forehead over the back, the sides, and upper surfaces of arms, legs and tail. The under surfaces of the arms, legs and tail, with the chin, breast and belly, had no spines, but were covered by dusky hairs. These spines were covered and concealed by dusky hairs, except on the back of forehead, lower third of back and upper surface of tail. In these parts, especially on the back and tail, these spines or quills lay in parallel rows like the teeth of a fine ivory comb. This description is taken from the animal while in repose. When excited hairs and spines, except on the tail, stand in thick perpendicular confusion, the tail being lashed from side to side. These spines are from three inches long to so small a size that you would not know of their existence, unless you stroked the animal backwards or from tail to head. They are white tipped with black. I think he has the power of voluntarily detaching his spines, but not of casting them. His simple defence is striking quick lateral blows with his tail. Every blow leaves some spines sticking to the object it strikes. In figure he has a stout blunt head, ears buried in hairs, a dull eye, yet a sad and expressive one. His neck is short, his back very arched, his arms and thighs muscular, curved and strong. He has four toes and a tubercle or rudimentary thumb on his fore feet, and five upon his hind. Both fore and hind toes are armed with strong nails, and both palms and soles are naked, and fringed by short bristles. The tail is about eight inches long covered by spines upon the upper surface, lying each side the medium line in parallel rows, interspersed by black hairs.

This bristly figure is a solitary one. He dwells in our thickest pine woods. He loves the sterile rocky ridges, crowned with rampikes and dwarfed scrubby pines. Such a ridge runs northeast from St. Margaret's bay, into Hammond's plains. Here in old times one might see half a dozen nailed to the door of the little out-post that covers the highway at Hubley's, on the St. Margaret's bay road. These were the sylvan spoils of the idle lookout. I have both met him in the forest and watched him in confinement. The first time I came upon him we were on the shore of the great Rosignol, our provisions low, our Indians hungry. Three or four wild fellows knocked him over with sticks, scalded, scraped and boiled him in an hour. I accepted a bit of flesh from their dirty fingers to say I had eaten porcupine, but that is all I could say of him. I came upon him again, on the western slopes of the Dalhousie hills, as the setting sun was sending its long beams athwart the pines. To dismount, and after a chase to hold him to the ground by a short stick, and armed with a stout buckskin glove to seize his spiny leg, was the work of a few minutes, and not many more to have him secure in a barrel at a settler's house. He afforded me many happy hours afterwards.

Some years afterwards I met him again in the wild country then, about Liverpool Head, but now traversed by a mail coach and four. At scarce sunrise of a lovely August morning we came upon a windrow, or where some forgotten hurricane had leveled the forest for acres, leaving the huge and now rotting tree boles overgrown with bush. We stayed our shying horses at the crackling of dead wood and waving of branches, expecting at least to see a bear come into the open. But out came a huge porcupine, going at a slapping pace. I pushed my pony mare into the bush to enjoy, as long as possible, the sight. Over the wind-falls and down the cradle hills he scuttled along,—going well off the ground, head down, tail curled up, with a lift behind in his gallop. Whether it was the morning air or the pace, or the internal feeling of some great business on hand, contrary to usual, his coarse rough hair and spines on his back were erect and horrid. We gave him good speed as his orbicular figure disappeared in the bush. His habits are very solitary. He makes his den beneath logs or stones, going off by day and returning by night. His well beaten road over the snow, from his feeding grounds to his home, I have crossed in winter, and seen young fir trees entirely denuded, standing like skeleton umbrellas out of the deep snow, surrounded by a circlet of their green branches lying on the snow at their base. This is his work. He prefers the tender bark of the hemlock when he can get it, but will take that of other pines. He also loves apples when he can get them, where the trees have sprung up in a forest opening from seeds either dropped by birds or planted by some forgotten settler. He is no fighter, but when he cannot escape, he stands on his simple fence, his head covered by an old tree or rock, his back presented to the foe bristled and spiny, and his tail slowly moving from side to side. However simple, it baffles any carnivorous son of the forest, save the fisher, which is said to run in upon his guard, trip him over and chop his belly, like, I fancy, I have seen a greyhound trip a Shropshire hare on the Longmynde. This is the tradition of the camp-fire as well as the lore of books. The quills barbed at the end with microscopic barbs, never come out, if once fastened into the skin and muscle, but work themselves forward and approach the surface often eight or ten inches from where they entered. I saw one that worked in this way around the back of a child. When numbers are left sticking into the mouth and face of dogs, which is the usual and most natural place, the poor brute often dies from the inflammation caused. The one I caught upon the Dalhousie hills, I kept in confinement until he escaped. Another which had ventured into the open, and which I rescued from some boys, who were forcing with sticks the position he had taken up beneath a post and rail fence, I also kept. From them I learned they loved the hemlock bark most of all the pines, though lettuce, tender raspberry and young willows were greedily devoured. They eat their food sitting upon their haunches, and use the palms of their fore feet in feeding. Indeed, the fore paws had almost the free circular movement of the bear. Unlike any other mammal they carried the head perpendicularly down, the nostrils presenting downwards. At first I never approached them, but they retired to a corner hiding their heads and erecting their spines; but they soon paid me the compliment of remaining on a peace establishment.

One day Indian Molly peeped over the pen as I was watching my pets. "Indian people keep porcupine, too." "Do they," said I, "and what do they eat?" "I 'spose eat anything, eat bread, eat meat, eat apples, eat potatoes, love soup, and never go so," said Molly, puckering up her mild Micmac face, and holding up her ten fingers and thumbs to show they never lifted their spines, "but run in and out camp like little dog, and never go woods." Many years afterwards I had the opportunity of studying one again. It was about two-thirds grown, and belonged to Mr. James, City Missionary, who kept it at Ainsley's stables. In it were developed, in a much higher degree, the peculiarities I have been endeavouring to show,—the very round back, the head held perpendicularly downwards, and the tail curved upwards. It stood well off the ground, and was very nimble in its actions. It climbed readily, even so small an object as a walking stick or clothes prop, clasping its object with all that beautiful flexibility of fore paw seen in the bear. It amused itself with turning round upon its own axis like a puppy hunting its tail, keeping up a low whimpering cry. It was very fond of being noticed, and I have frequently seen it lying on the neck of a young girl with its curved paws clasped around her throat. It ate bread, apples, potatoes, turnip peelings, in short almost everything, sitting upon its haunches and using its fore paws with the palms upwards.

This little animal will long grace our forests. His only enemy, the fisher, is all but extinct, and the uninviting barrens he loves will never tempt the settler. Seen either winter or summer, his bristly figure accords well with the scene. On a hot August day when crag and moss and rampike, with dwarfed pine on our barren ridges are crackling in the sun's heat, there is nothing drier, nothing so arid as himself, making us think as he does of his African cousin. Or, again, how appropriate to the scene he looks tracking the snow wastes, or sheltering in some snow-loaded spruce, how like a part of the tree he looks, how hard, how spiny, how regardless of the storm that rages over his insensible back, as it does over the insensible tree on which he cowers for shelter.

NOTE.—Of all known animals the porcupine is most infested by tape worm. The intestines are completely filled by them, and this in numerous instances. It is of a different species to the human variety.

ART. VIII. NOTES ON THE MARINE ZOOLOGY OF NOVA SCOTIA. BY J. MATTHEW JONES, F. L. S.

(*Read April*, 1870.)

I HAVE chosen the above title for the paper I have to bring before the Institute in order that it may be understood that I do not pretend to offer a complete paper on so extensive a subject as the marine zoology of our coast, but merely scattered notes and observations in regard to the several species belonging to separate families and genera, which from time to time I have an opportunity of collecting and identifying. It is better thus to publish these desultory facts as they become known to me than to await the completion of an extended systematic list which can only be consummated by the observations and collections of several years; and more particularly for the reason that the present knowledge of the geographical distribution of marine forms on the north eastern coast of America especially in this northern latitude may be extended with the least delay, for it may be said with truth that the shores of our Province are almost untouched ground. When sufficient species are collected a synopsis may be made, but until that event is accomplished, I will (D. V.) proceed with a system of occasional notes.

Description of Halifax Harbour.

The harbour of Halifax is situate in Lat. 44° 39′ 38″ N., and Long. 63. 35. 10. W. It lies nearly N. W. and S. E., and is acknowledged to form the finest harbour on the east coast of North America. At its entrance it is about three nautical miles wide, taking Chebucto Head on its west side, and Hartland Point on the east as the two points. On its western side it is deep even to a few feet from the shore, having some three or four fathoms water quite close in. Nearly in the centre of the harbour, and sheltering its upper portion from the heavy "south-easters," lies Macnab's Island about one mile and a half in length by three quarters of a mile in breadth at its northern end, and becoming a narrow point at its southern termination which points out to sea. Between this larger island and the eastern side of the harbour lies another island, about half a mile in length and a quarter of a mile wide, known as Lawlor's Island. These two islands have been the means of causing a change in the depth and bottom of the harbour along its eastern side as far as Fort Clarence, and therefore a difference in the marine fauna.

Nearly opposite the north west end of Macnab's Island on the west shore, a narrow inlet about a mile and three quarters in length by a quarter in breadth runs up. It is known as the North West Arm and is a deep channel lying between high banks. It has from six to nine fathoms water in its centre from the entrance to a spot called "Melville Island" near the head. From the north end of Macnab's Island the harbour contracts, especially at a place called "The Narrows," where it is only some four hundred yards wide, but it opens again into a large expanse known as "Bedford Basin," a sheet of water about eight miles long by two and a half at its widest part. This basin is funnel shaped, the bottom gradually sloping from all sides to the centre which has a depth of about forty fathoms. Such is a short and rough description of the principal features of the harbour of Halifax. We will now proceed to describe the nature of its bottom.

At its mouth where it lies exposed to the full swell of the Atlantic, the ground is rock and sand with a general depth of from twenty to twenty-five fathoms, save here and there where groups of rocks form shoals at a depth of four or five fathoms. From the outermost shoals known as Portuguese, and Rock Head, Shoals, to the east side the depth is about nine to eleven fathoms, with a more rocky bottom until within a short space of the shore where it shallows rapidly to three fathoms and less. Approaching Macnab and Lawlor islands, we find the ground gradually exhibiting the effect of these barriers in the accumulated mass of sand and gravel off their southern edges, where bars are formed having only one to one fathom and a half at low water. Between Macnab's Island and the eastern shore the channel called "The Eastern Passage" is nowhere deeper than eleven and generally not more than six fathoms with a bottom of deep sandy mud. The main channel of the harbour from abreast of the south end of Macnab's Island, and being to the westward of that island, all the way up to the "Narrows," has a bottom of sandy mud, (but nothing like so thick as that of the Eastern Passage) sprinkled here and there with rocky ledges. Bedford Basin presents a varied bottom of rock, gravel, and sandy mud; while at its deepest part in the centre it is either very hard sand or smooth rock, for the dredge meets with no resistance and brings up scarcely a form of any kind.

Boltenia clavata, Fabr.

One of the most singular in form of the marine invertebrates is the *Boltenia* a tunicate mollusk growing on a lengthened stem, in some cases no stouter than a grass stalk. This genus appears to have been but little studied, for although I have consulted several leading works on the Mollusca, I have gained scarcely any knowledge of its anatomy. All the authors who mention it, agree that it is furnished with an elongated peduncle or stalk, whose base is fastened to a rock or other suitable anchorage, but none offer an opinion as to the use and true nature of the peduncle on which the ascidian grows like a pear depending upon a branch. Gould, who describes four species, and is more explicit than other authors, only gives the following particulars regarding *Boltenia clavata*. "This is a most curious object and greatly resembles in shape the flower of the Ladies' Slipper (*Cypripedium*) on its stalk. It has a kidney shaped body, of a wrinkled, leathery structure, about two inches long and one in width, suddenly narrowing at the top into a small stalk not larger than a crow quill, and from six to twelve inches in length. It has two cross-shaped orifices, nearly an inch apart. It is attached by its stalk to stones in deep water, whence it is occasionally hooked up by the fishermen, or driven on shore by storms. Its surface is usually loaded with marine plants, zoophytes, &c." Dr. Stimpson in his "Invertebrata of Grand Manan," thus describes the same species—"It is very distinct from *B. rubra*, being uniformly of a fine yellowish white colour, with a smooth velvety surface. It inhabits rocks in deep water, never occurring in less than fourteen fathoms." The first author who noticed it was the talented Fabricius, and he describes the species under the name of *Ascidia clavata* in his Fauna Groenlandica published as far back as 1780. New discoveries, however, having brought to light other species of this stalked ascidian, it was considered advisable to form a special genus for them, and MacLeay in his excellent memoir published in the XIV. volume of the Transactions of the Linnean Society gave the name *Boltenia*, after Dr. Bolten, and described this species as *B. reniformis*, doubtless from its being somewhat kidney shaped. Fabricius's specific name, however, which was not a bad one, (meaning, "a hard fleshy knob",) is that now claimed for it under the late law of Zoological nomenclature, which rules that the first specific name given to a form, if it be not absurd, shall be retained, leaving it optional for monographers to class such species in new genera whenever the discoveries of science prove such want.

On carefully examining a specimen in my collection preserved in alcohol taken on our coast I am enabled to offer the following particulars :—

Length of sac	2 inches 2 lines.
Breadth of sac	1 inch 5 lines.
Length of peduncle	9 inches.

On opening the peduncle from sac to base I found it hollow the entire length, excepting perhaps half an inch immediate to the root itself, which is composed entirely of fibrous cords traversing and interlacing each other, and in some parts forming a solid mass particularly at the peduncular base. On careful search I could discover no communication between this hollow stem and the sac. Traversing what may be termed the dorsal region of the peduncle I found a fibrous or muscular cord continuous throughout its length, evidently serving the purpose of a vertebral column,* but singular enough I found a communication between this muscular column and the sac, being able to push a very slender wire about half an inch from the sac down it, but although I tried force it would pass no further. There may have been a stricture in the passage, or it may have been a natural termination to so short a channel; if the latter be the case I am puzzled to make out of what use such a short channel can be. As regards the use of the muscular column, it is probable that it can be stiffened or relaxed at the will of the animal and that in either case to enable the creature to bend its sac to the surrounding sea bottom, or keep erect. The peduncle is wholly ramified by muscular cords which evidently give it its peculiar toughness. The sac also is of a leathery consistence but more delicate in appearance, although thicker and equally tough.

On the stem of one of my specimens, which was kindly given me by Lieut. Worgan, of H. M. S. "Wolverine," having been brought up while sounding in about 100 fathoms, 80 miles east of Cape Breton, there exists an abundant parasitic growth, among which a polyzoan of the genus *Cellepora* is very prominent encrusting the stem and adhering to the sea weed which also clothes it. Minute specimens of *Saxicava rugosa* are enclosed here and there in the cellepore mass, and at intervals a small and handsome coralline occurs. I also obtained several rhizopods on searching the parasite growth with the lens, all belonging apparently to one genus the *Nonionina* of D'orb. Judging from the the three specimens of Boltenia in my collection, I imagine that the growth of parasites exists in greater or less profusion according to the age of the animal, as the peduncle of Lieut. Worgan's example had become hardened and woody, doubtless from age, and the *cellepora* which formed a complete crust around it, had at the base died, and its surface was smoothed precisely as I have found aged coral dead and worn by time at the base of a recent growth in the Bermudian waters.

The geographical distribution of *B. clavata* on the east coast of America, appears to extend from New York to the Arctic

* It may be well to state that while examining this specimen, I knew nothing whatever of the discoveries of Kowaleysky and Kupffer.

Regions, as it has been taken off the New York shore; on that of Massachusetts; at Grand Manan, Bay of Fundy; in the Straits of Belle-isle, Labrador; and in Greenland. From our coast I have the Cape Breton specimen, and one, kindly given by my friend the Rev. J. Ambrose, taken near Margaret's Bay, which has afforded me the descriptive particulars above.

Mr. Ambrose also recently brought me a very fresh specimen of what I think will prove another species of this genus, *B. rubra*, as it corresponds in size and other particulars. The sac before immersion in alcohol was of a brilliant crimson, which soon changed in the spirit to a dull brown, and in time will turn white.

Star Fish, (*Uraster rubens*, Lin.)

The next form to be treated of in these scattered notes is the *Star Fish*, than which none other perhaps is better known to the fisherman and dredger. Several species are known on every coast, and in every clime; those which are more robust in form preferring the shallow waters of the littoral zone, while others again are only found in deeper water where the bottom they feed upon is less agitated and more suited to their graceful and brittle forms. Of the former we have the common star fish, or "cross-fish" of the fishermen (*Uraster rubens*, Lin.) so common indeed, that no particular description need be given of it. But there are some points in connection with its appearance which are not generally known and therefore may be worth noticing. In the first place it is usually found with five rays (which I may state is the character of most species of star-fishes) but not unfrequently with six, and in some instances it is found with one of the rays forked; and in a closely allied species which I found in the Bermudian waters one limb was divided into three smaller ones. Another singular character of this species, which is held in common by other members of the genus, is a curious wart-like process to be found on the dorsal surface, between the bural fork of two rays. It is precisely like a male madrepore coral, and under the microscope presents the same sutural aspect as the fungoid corals. It is named in consequence the *madrepore tubercle*, and it is connected with the interior of the animal, but its real use has not been satisfactorily determined.

Specimens of *Uraster rubens* may be obtained of all sizes from the size of a sixpence up to those of a foot in diameter.

Limnoria ——— ?

Another marine invertebrate whose existence in Halifax harbour, I may say I have the sorrow to make known to you, is one of the most destructive creatures to wood work under water, known. It is the same species or very closely allied to the *Limnoria terebrans* of the European coast. This little creature, scarcely larger than a cress seed will, when at work with hundreds and thousands of its race, as is usually the case, soon make short work of wharf piles, and wherever it exists it would be utterly useless to place wood work under water if it is intended to last for any time. It would be far cheaper in the end to build a stone wharf, and certainly more satisfactory, for every log immersed in this harbour, *unless it be of some wood which the Limnoria will not attack* must ere long begin to decay under the attacks of this horrible pest. The creature itself under the lens appears very like the wood-louse in form, is of a greyish colour and has two black eyes. It was Stevenson the engineer who first made its ravages known, for he found it very destructive to the wood work necessary in laying the foundations of the Bell Rock Lighthouse, which it permeated in every direction. It is known in the French harbours also as an intensely destructive agent wherever submerged wood occurs. It enters the wood for a depth of at least two inches boring (as you will perceive by the specimen I exhibit) in every direction. So great is their destructive power and so rapid, that three inch fir or pine planking nailed on the north pier of Bridlington Bay, Yorkshire, has been eaten away in *the space of three years* to half an inch in thickness. It is therefore perhaps as well to make known its occurrence in Halifax harbour. The specimen of wood I exhibit bored by these creatures I obtained, after a heavy south east gale, on the Fishmarket Wharf, from a large pile lying high and dry literally honey-combed by these creatures. On passing by each wharf in a boat at low water you will readily perceive the great ravages these creatures make among the piles, which about half way between high and low water mark are eaten completely in, presenting the appearance of an hour glass.

ART. X. EXTREMES OF PRESSURE DURING THE WINTER OF 1869-70. BY FREDERICK ALLISON.

HAVING just passed through a season remarkable in several features, I propose this evening to look at the winter of 1869-70, particularly with respect to the violent—and sometimes sudden—disturbances of the atmosphere, which were marked in this neighbourhood by most extraordinary barometrical readings. To discuss this winter fully it would be necessary to bring together the results of all classes of observations. Those of the barometer, and of its attendant or partner the hygrometer, which tell of the changes taking place in the higher and more distant regions of the atmosphere, before they are otherwise felt by the observer; as well as those of the thermometer and of the wind which denote a present influence; and those of the rain guage which record accomplished facts. Also to mention the whole train of non-instrumental observations, which are very useful in registering various atmospheric, animal, and vegetable phenomena.

But it is not the aim of this brief paper to go farther than to record the more striking of the abnormal pressures during the period mentioned; with an occasional description of some of the most intimate of the accompanying events. All my barometric readings here given are reduced to 32° of temperature, and corrected to sea level.

December, 1869, was a month of peculiarly high barometers, but the readings of 9th and 10th, and of 21st and 22nd stand up prominently even there. At 9 p. m. of the first mentioned day 30.535 inches were marked; and the notation of 7 a. m. of the 22nd was 30.524. At these hours the elastic force of vapour was .070 and .061, respectively. It was not to be expected that so great elevations of the barometric column would be merely local; and we consequently find the mean pressure on the 8th at Toronto, in 5h. 17m. 33s. W., to have been 30.083, (not corrected for altitude) which had declined slightly on the 9th. The grade in this instance was comparatively gentle on a long slope. Nor was the rise sudden in the second case; extending here from the evening of the 19th over a period of about 60 hours. Looking westward again we see the culmination of this wave at Toronto early on the 21st;

and at St. John—in 66° 03′ W. longitude—during that night. A high barometer is popularly connected with fine weather and frost, and there is enough truth in this superficial belief to give it a fair foundation. But it would be difficult to reconcile with this creed the mild December of 1869, when rain measured 5.14 inches, besides .63 of melted snow; and whose wet days numbered 14. Both for abstract science, and the ordinary pursuits of men, greater attention should be paid to the rising and falling of the mercurial column than to the fignre at which it may stand on a particular occasion.

The very finest weather lasted during the rising barometer from the night of the 7th to that of the 9th without any great cold for the season; the mean temperature of the 8th being 21°.75; that of the 9th 21°.00; and that of 10th 26°.77. Again on 12th and 13th, when the barometer stood high with little fluctuation, the mean temperature of the 48 hours was exactly 30°.00, and snow fell between 2 p. m. of the former day and 4¼ p. m. of the latter to the depth of 1.7 inches. The afternoon of 21st and morning of 22nd, with the enormous pressure noted, were very fine, but the mean temperature of the one was 22°.67 and of the other 24°.33, and there was no constancy in the fair weather. A storm of snow and rain began on the latter afternoon and continued at night with a very high wind from S. S. E. to S., 1.67 inches of water were precipitated in less than 12 hours, the pressure decreasing rapidly during the night. The attempt to forecast changes, in the existing state of meteorological knowledge, is to be generally deprecated; but, were it otherwise prudent, the action, rather than the position of the column of the barometer should be carefully watched. It n ıst also be always remembered that the barometer marks the whole density of the atmosphere, and that we need the hygrometer to tell us the dew-point, and the elastic force of vapour, preparatory to understanding the amount of dry pressure, and what may be here called the dampness of the atmosphere. Every inquirer will agree with me that as he observes the complex nature of the various meteorological elements at any one place, and the inter-dependence of the relative values at different stations, he discovers that he knows comparatively nothing of the laws, actions, and quantities of this portion of the Divine Creation.

Examples of low barometers, confirmatory of the above remarks will be taken from later in the winter. Meanwhile let us turn to the peculiar pressure of 14th January and following days. The 14th opened in the middle of a snow storm and strong N. N. E. breeze, but the barometric column was striding upwards, and the snow and wind ceased early. The storm had begun the preceding afternoon with a high barometer. The pressure increased much during the 14th till it reached 30.609 at 11⅔ p. m. when the cold was intense. At 4 a. m. of 15th the temperature was — 3°.3 in Halifax and much lower at several other points; and the mean pressure of the day was 30.354. But this whole pressure was a decreasing one, while the pressure of vapour was vastly augmented, and the relative humidity quadrupled itself within 15 hours. Snow fell lightly in the afternoon. A rain storm commenced at 6½ p.m. The wind blowing a gale from the southward at night. I notice here that the crest of this wave of pressure which reached Halifax on the night of the 14th at the hour above mentioned, passed Toronto at 10 a. m. of that day, Montreal at 2 p. m., and St. John at 10 p. m. True, this maximum was marked at Quebec earlier than at Montreal, but the greater north latitude of Quebec must be taken into consideration. At 5½ a. m. of 16th the thermometer read 48°. 1—or a rise of 51°. 4 in 25½ hours, and the barometer at 7½ a. m. 29.585, or a fall of 1.024 inches in less than 32 hours. What conclusions would have been drawn by a superficial observer, paying regard only to the position of the barometer on the 14th; and not considering its action, nor the movements of other instruments and elements. Certainly he could not have guessed that a heavy rain and gale were at hand.

The great atmospheric disturbances which prevailed at the end of January and beginning of February cannot pass unnoticed. During the forenoon of the 29th we find the barometer again above 30 inches. A temperature rather low. The force of vapour not great, but increasing very much as the day progressed. An average humidity; a sky almost cloudless; and gentle airs from N. E., veering towards S. E. In short, a morning with the atmosphere apparently in equilibrium. That night a great decrease of pressure was noted; and at 8¼ next morning it had diminished to the extent of 1.69 inches in 20¼ hours. The wind had backed to E. from nearly S., and a strong gale was blowing. Rain began in showers about 4 a. m. but soon changed to snow, which fell fast until noon. The wind was working up to N., which it finally reached. Quickly as the barometer had descended, it rose as suddenly during the afternoon of 30th, while the wind lulled, and the clouds rolled off soo rapidly. But this was only one inequality surmounted; one toss of the wave heaved over us by conflicting currents. Again on the last night of January the barometer was rushing downwards, falling 1.103 inches in 20 hours at Halifax; which decline was attended by a heavy snow storm with high wind backing from S. E. to N. N. W.; and the corresponding rise of the 2nd was marked by one of the finest days of this winter. But while nearly 7 inches of level snow fell on the 3rd, the column of mercury stood high and comparatively steady. So on the 13th, when there was but little oscillation, and a mean pressure as low as 29.507, a remarkably fine day was enjoyed, with a temperature—24°. 03—within .54 of the mean of the month. A scanty force of vapour and extremely dry atmosphere, giving only 18 per cent of relative humidity at 9 p. m. These examples alone are sufficient to prove that the absolute height of the barometer by itself betokens nothing.

In any consideration of atmospheric pressure a note should be made of the extraordinary 9th of February last. There was a fall from 8th, 9. a. m., to 9th, 7. m. of 1.423 inches—28.617 being the reading at the latter hour—and a rise till 12th, 4 a. m., of 1.264 inches. Snow lasted from 7.40 p. m. of 8th to 5 a. m. of 9th, and again from 5 to 9½ p. m. of the latter day. An E. gale blew that morning. At noon wind was S. W. but scarcely perceptible. During afternoon it backed to S. S. W., and once more came up to W. with much force at night. These struggles in the air, resulting in frequent precipitation, and differing currents, could not but be marked on the thermometer also; and we find the mean of this instrument on the 10th, 11°. 27 lower than that of the 9th.

From the 24th to the end of February occurred a repetition of disturbed pressures, widely felt, at least through British North America. Here on the first day of this term we had a descending column till 9 p. m., when the low figure of 28.825 was reached.

A little snow fell early, but torrents of tain accompanied this descent, and the gauge at midnight held 3.10 inches. The movements of the wind were very interesting. The preceding day had closed with a gentle S. W. breeze, but it was strong from S. S. E. at 4 a. m. of 24th; backed to E. before 7 a. m.; veered E. S. E. and reached a gale at 8 a. m. This soon fell, however, and the force gradually lessened for over 8 hours; the direction meanwhile changing to S. Again the wind rose after 5 p. m., and was very high in early evening, shifting between S. and S. E. Soon after 8 p. m. it settled in S. and blew a strong gale, which lasted a couple of hours, but the wind was very high all night. It may be seen here that the strength of this gale was divided into two portions; coincident in the first place with the greatest pitch of the downward gradient—.120 inch between 7 and 8 in the morning,—and in the second with the first turn to rise between 9 and 10 in the evening. From the lowest point mentioned the barometer rose for 24 hours, continuously though slowly. Should the very slight pressure of the 25th have been regarded by itself alone, an error as to the probable weather would have been made as important as that alluded to on the 14th January, for although clouded this day was by no means unpleasant. On the 26th the barometer continued very low, but rose more quickly after 10 a.m., temperature was lower, and the air almost calm; but cloud was unsettled in quantity and appearance. The double maximum and minimum of the barometer due to our geographical situation, are already plainly distinguished in Nova Scotia; though until more systematic observations in longer series be collected, I object to fixing positively the hours of these events. Nevertheless it may safely be said that a barometer rising fast during the middle of the day, when it should be declining to its second minimum, deserves to be looked upon with great suspicion. The rise just noticed was suddenly checked in the evening, and during the 27th but little variation took place till late in the afternoon. A gentle snow fall of less than half an inch occupied four hours in the morning. The mean pressure of the day was only 29.502; but the temperature was pleasant, while a very moderate polar current drew over the surface of the earth. On the last day of February, the barometer once more sank to a very low reading; which was accompanied by a considerable precipitation in the form of snow, and a light breeze, moving at first from N. N. E. to E. S. E., but afterwards to E., E. N. E., and still farther towards north. Nor was this remarkable depression recovered during this month, as March came in with a barometer far below any approach to the normal.

It is, however, needless to follow farther this movement at this point, while it may be instructive to view the pressure during the same days in other localities. At Glace Bay, Cape Breton, in Lat. 46°. 12′ N.; Long. 59°. 57′ W., the barometer was falling continually from the evening of the 23rd to the afternoon of the 25th, when it marked only 29.028, and a S. E. gale on the night of 24th blew with a force of 12 lbs. per square foot, or a velocity of 49 miles per hour. The temporary rise and subsequent renewed fall were also very evident there. The Windsor readings in 44°. 58′. 30″ N., and 64°. 7′. 30″ W., were also at this time in conformity with the usual law. 28.970 was there reached at 9 p. m. of 24th, and after $\frac{3}{4}$ inch of snow that morning, rain fell all day with a heavy S. gale.

It is not intended to describe here the low barometers of the middle of March, as I have so recently detailed them with their attendant storms, stretching over this and the neighbouring Provinces with more or less severity for several days; but the repeated fact is again noticed that the disturbances took place while the column was in motion; while, on the 20th in Halifax for example, when the pressure was almost steady though decidedly low, we experienced very fine weather and a cloudless sky. I am here reminded of the peculiar light, of a green tint, which on the previous evening was thrown over the earth. The clouds had broken just before sunset. In the east rose-tipped grey cumuli drove over a dark blue background. In the west was light blue sky, yellowish green at the horizon, and cirro-cumuli curiously folded were rising from that direction, tinged with the red light of the setting sun. But on the earth itself these red colours were completely absorbed in the greenish hue above mentioned. The temperature was 29°. Wind very high from N.; and the atmosphere had a relative humidity of 72 per cent.

The last instance of pressure to be brought forward in this winter is the high barometer of 26th and 27th March. On the night of the 25th the sky cleared with a rapid increase of pressure. The 26th was bright and clear, with still a rising barometer. Next day there was scarcely any variation in the pressure, and the mean, 30.382 was remarkably high; but the day was not so fine as the preceding one. The temperature was more chilly. Cloud was much more plentiful; and a close observer might have detected the gale which was very near. At Glace Bay the barometer remained above 30 inches for the six closing days of March, but we cannot point to that period as one of fair weather by any means. Cloud was abundant during four days of the six. A strong gale from N. blew on the 26th at the rate of 43 miles per hour from 8 a. m. to 6 p. m.; and brisk breezes and high winds characterized the remainder of the month. The temperature was not unseasonable. At St. John, N. B., the indicated pressure, corrected for temperature only was 30.514 at 8 a. m. of 27th, and "a fierce easterly gale" with "the heaviest rains of the month" was recorded there on 28th and 29th. At Windsor the same features were observed, though more moderately than elsewhere.

Mr. Buchan makes some remarks on the distribution of pressure, which are not inapplicable here. In Chapter VII. of his admirable handybook of Meteorology he tells us that the current of air is from the regions of high to those of lower pressure, and illustrates his position by some striking examples. This fact may be farther exemplified by the occurrences of last winter in this Dominion. The more recent of which will suffice for our present purpose, without wearying my audience with too numerous details. At 8 a. m. of the 17th February the barometer in St. John, N. B. stood at 30.504; in Halifax at 30.301; in Glace Bay at 30.225. A N. W. wind prevailed over Nova Scotia. At 2 p. m. of the 1st March the barometer at the same place stood respectively at 29.250, 29.058 and 29.103. At Halifax, as might be expected, we again find the wind N. W., and the same at stations to the west of us. But down in Cape Breton a more variable disposition is manifested, and as the barometer at this date never fell so low there as here, a N. E. current was apparent that evening. Probably, could an observation have been had off this coast, about 50 miles to the southward, a still lower pressure would have been obtained. The same rule holds good when the pressures are declining from east to west. Thus on 22nd March at 2 p. m., the barometer at Glace Bay marked 29.784, with a breeze light from E. Here the reading was 29.529; gentle breeze shifting between E. and S. E., and general S. E. currents through the Province, stronger at the more northern points. It must be borne in mind that in revolving storms, or cyclones, the direction of wind is also always to the area of least pressure, or in other words towards the centre of the storm; but these directions are purely local, and not to be taken into account when an extended surface of the earth is considered.

Another interesting feature in these differences of pressure is the amount of rain or snow by which they are accompanied. It would be well now for the inhabitants of the eastern slope of America to disabuse their minds of the idea forever that east winds in their country are the cold dry and raw currents which render western Europe so disagreeable at some seasons. An east wind in England and an east wind in Nova Scotia is an influence as different as land and water in the more substantial world. As before alluded to, the elevation of the barometer about 9th December, 1869, was surrounded by very fine weather. The great pressure of 22nd of that month was followed immediately by snow, and violent rain; and although a rapid decrease took place during that night, it never fell much below the normal, and the mean of 23rd was 29.677. In the first instance the wind moved regularly from west to north west between 8th and 9th and was afterwards variable and light from E., N. E., N. and W., shewing a probable high pressure on all sides, sufficient to bring into play the local and minor influences. In the second case the wind had been N. W., veering N. also; but a storm with a direction here from S. E. and afterwards with more force from S. rushed in suddenly, upsetting any theory founded solely on a high barometer. The rain in this storm was due to the customary condensation of the equatorial current on meeting with colder strata. But a noteworthy instance of precipitation with a great and slightly increasing pressure is that of 3rd February. On that day the barometer read 30.092 at 7 a. m.; 30.116 at 2 p. m.; 30.194 at 9 p. m.; and there remained with scarcely perceptible change until next morning at 7 a. m. when it rose a little farther. The temperature of the air was low, varying from 14°.6 about 2½ p. m., to 4°.7 at midnight and falling to 3°.1 at 8¼ a. m. on 4th. Wind was gentle from N. E., growing brisk at night, and veering N. next morning early. Flurries of snow were falling during the day till 4 p. m., when they settled into a fast fall till 11½ p. m. Nearly 7 inches of snow fell during these 7½ hours. In western Europe where a high barometer generally accompanies eastwardly winds under any circumstances, the N. E. direction might sufficiently account for this pressure with a heavy snow fall. But not so in Nova Scotia. We must look to other causes; and find them in the fact that a still greater pressure was being exerted on either side of us. Halifax, though itself occupying, as it were, a high position, was in a depression between great elevations both westward and eastward. Air flowed down upon us, until our only relief was in the mentioned snow fall. Had the earth been stationary the wind's direction would have been north and not north east. After the precipitation, the very high barometer, the severe cold, and N. wind inclining to N. W., of 4th and 5th were in accordance with theory and observation.

I will here close the main subject of this paper, asking the lenient consideration of the more experienced for deficiencies, which have been apparent to myself while endeavouring to deal with most important matters. I must, however, occupy still a few moments that I may conclude a discussion of the interesting phenomenon of the Aurora Borealis, which I began in 1868, and which on several occasions I have been requested to continue. I think I have established the fact, based upon a record of twenty observations, impartially selected from a much larger number, that the Aurora Borealis is not a constant precursor of southwardly gales or rain, as it has been sometimes considered to be. Does any change of weather accompany this phenomenon; and, if so, what may be its nature? In answer to these questions I think it may be proved that this Polar illumination is never visible except with a decrease of temperature; and that this change is generally sudden and considerable. That such change renders precipitation imminent is also undoubted, and hence it is that an equatorial indraught and rain frequently follow an observation of the Aurora Borealis. But again they are often absent, and by no means a consequence of this

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186[illegible]	Oct.	Nov.	Dec.	Year 1869.
Mean Temperature, ...	48°.42	36°.76	32°.05	43°.20
Difference from average	+2.09	-1.61	+6.18	+.05
Maximum Temperature,	74. 4	55. 5	53. 8	80. 8
Minimum Temperature,.	22. 9	18. 8	12. 2	-6. 8
Monthly and Annual Ran	51. 5	36. 7	41. 6	87. 6
Mean Maximum Tempera	57.13	41.63	38.52	....
Mean Minimum Tempera	40.58	30.84	25.05	....
Highest Daily Mean, ...	65.42	50.00	47.68	68.67
Lowest Daily Mean,....	28.24	25.42	17.83	2.50
Mean Daily Range,.....	16.09	9.80	10.30	16.62
Greatest Daily Range,..	34. 5	29. 5	31. 2	38. 1
Mean Pressure, corrected	29.789	29.680	29.947	29.788
Difference from average	+.010	-.047	+.207	+.030
Maximum Pressure, ...	30.198	30.366	30.535	30.535
Minimum Pressure,.....	29.241	29.068	20.115	28.761
Monthly and Aunual Ran	0.957	1.298	1 420	1.774
Highest Daily Mean,....	30.120	30.120	30.419	30.419
Lowest Daily Mean, ...	29.275	29.172	29.309	28.992
Mean Elasticity of Aque	.286	.154	.127	.255
Mean Humidity, ...	74.8	64.1	61.2	75.2
Mean Cloud,..........	5.5	7.0	6.3	5.8
Difference from average	-0.2	-0.3	-0.3	-0.4
Prevalent Direction of W	N.W.	N.W.	N.W.	N.W.
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GENERAL METEOROLOGICAL REGISTER FOR 1869.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea, 130 feet.

1869.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sep.	Oct.	Nov.	Dec.	Year 1869.
Mean Temperature,	23°.29	26°.13	26°.16	38°.72	47°.35	58°.86	63°.50	59°.62	57°.50	48°.42	36°.76	32°.05	43°.20
Difference from average (seven years)	+1.42	+2.41	-1.93	+.82	-.33	-1.17	+ 35	-3.37	-.21	+2.09	-1.61	+6.18	+.05
Maximum Temperature,	54. 3	44 2	52. 5	68. 7	77. 7	80. 7	80. 8	79. 9	78. 9	74. 4	55. 5	53. 8	80. 8
Minimum Temperature,	-6. 8	6. 3	-5. 0	23. 2	22. 1	38. 6	46. 9	42. 3	35. 1	22. 9	18. 8	12. 2	-6. 8
Monthly and Annual Ranges,	61. 1	37. 9	57. 5	45. 5	55. 6	42. 1	33. 9	37. 6	43. 8	51. 5	36. 7	41. 6	87. 6
Mean Maximum Temperature,	30.59	33.98	34.99	48.28	60.55	69.15	73.16	70.98	68.81	57.13	41.63	38.52	....
Mean Minimum Temperature,	14.84	18.25	16.21	29 29	38.35	49.13	54.11	51.46	49.93	40.58	30.84	25.05	....
Highest Daily Mean,	43.75	37.25	41.17	50.42	56.75	64.42	68.33	64.09	68.67	65.42	50.00	47.68	68.67
Lowest Daily Mean,	2.50	11.58	8.00	30.33	34.17	51.00	54.17	54.92	48.33	28.24	25.42	17.83	2.50
Mean Daily Range,	15.70	15.17	18.40	19.00	23.50	16.70	18 60	18.70	17.60	16.09	9.80	10.30	16.62
Greatest Daily Range,	30. 1	26. 4	38. 1	32. 3	37. 8	34. 4	25. 8	28. 7	30. 3	34. 5	29. 5	31. 2	38. 1
Mean Pressure, corrected,	29.710	29.828	29.828	29.641	29.601	29.834	29.762	29.816	30.018	29.789	29.680	29.947	29.788
Difference from average (seven years)	+.011	-.025	+.078	-.103	-.083	+.076	+.001	+.056	+.177	+.010	-.047	+.207	+.030
Maximum Pressure,	30.334	30.394	30.393	30.113	29.975	30.070	30.163	30.231	30.304	30.198	30.366	30.535	30.535
Minimum Pressure,	29.296	28.761	29.033	29.317	29.061	29.401	29.246	29.351	29.508	29.241	29.068	20.115	28.761
Monthly and Aunual Ranges,	1.038	1.633	1.360	0.796	0.914	0.669	0.917	0.880	0.796	0.957	1.298	1 420	1.774
Highest Daily Mean,	30.056	30.322	30.313	29.967	29.944	30.043	30.024	30.203	30.260	30.120	30.120	30.419	30.419
Lowest Daily Mean,	29.412	28.992	29.260	29.389	29.149	29.554	29.364	29.507	29.668	29.275	29.172	29.309	28.992
Mean Elasticity of Aqueous Vapors,	.109	.117	.123	.193	.298	.420	.439	.410	.380	.286	.154	.127	.255
Mean Humidity,	71.0	74.9	78.9	75.9	86.4	87.0	76.6	75.0	77.0	74.8	64.1	61.2	75.2
Mean Cloud,	6.2	6.5	5.5	6.3	6.8	5.6	4.3	4.5	5.5	5.5	7.0	6.3	5.8
Difference from average (three years)	-.2	+.4	-.4	+.1	-.4	-.3	-1.5	-0.8	-0 6	-0.2	-0.3	-0.3	-0.4
Prevalent Direction of Wind,	N.W.	N.W.	N.W.	S. E.	S. E.	S. E.	S.W.	N.W.	S.W.	N.W.	N.W.	N.W.	N.W.
Mean Force of Wind,	2.1	2.5	2.2	2.0	1.9	1.5	1.6	1.6	1.8	1.8	2.1	2.2	1.9
Difference from average (seven years)	-.2	+.2	-.1	-.5	+.1	-.4	-.3	-.2	-.1	-.5	-.4	-.3	-.2
Amount of Rain,	3.04	3.20	4.11	2.21	5.51	3.92	2.92	2.58	1.57	7.03	5.19	5.14	46.42
Difference from average (seven years)	-.74	+.26	+.91	-.81	+1.02	+.85	+.87	-.78	-2.33	+2.15	+.66	+1.59	+3.65
Number of days Rain,	5	6	6	9	15	11	8	8	8	14	10	11	111
Difference from average (seven years)	0	0	0	2	-2	-1	-3	-3	-3	+1	-3	+3	-13
Amount of Snow,	14. 0	8.4	29.3	2. 7	.5	0	0	0	0	2.3	3.5	4.8	65.50
Difference from average (seven years)	-2.28	-1.99	+12.10	-6.25	+.4	0	0	0	0	+1.6	+.3	-9.8	-5.92
Number of days of Snow,	7	4	4	3	1	0	0	0	0	1	2	5	27
Difference from average (seven years)	-3	-4	-4	-2	0	0	0	0	0	-1	-2	-6	-22
Total Precipitation,	4 53	4.38	7.95	2.57	5.57	3.92	2.92	2.58	1.57	7.30	5 [illegible]7	5.77	54.53
Difference from average (seven years)	-1.18	-.78	+3.57	-1.45	+1.07	+.85	+.87	-.78	-2.33	+2.31	+.[illegible]4	+1.12	+3.81
Number of Dry Days,	21	19	21	20	16	19	23	23	22	16	18	17	235
Difference from average (seven years)	+4	+3	+3	+3	+2	+1	+3	+3	+3	+3	+4	+3	+35
Number of Fogs,	1	2	2	2	6	5	5	1	5	4	0	3	36
Auroras,	0	4	4	8	3	3	1	4	6	3	2	1	39
Hoar Frosts,	4	4	8	3	1	0	0	0	1	2	6	8	37
Thunders,	0	0	1	0	2	1	0	2	1	1	0	0	8
Lightnings,	0	0	1	0	2	1	0	2	0	1	0	0	7
Lunar Halos,	1	1	2	1	0	0	0	0	2	1	2	2	12
Solar Halos,	0	0	0	0	0	0	0	0	0	0	0	0	0
Hails,	0	0	0	0	0	0	0	0	1	0	0	0	1
Rainbows,	0	0	0	0	2	0	1	0	0	1	0	0	4
Days Sleighing,	10	23	14	0	0	0	0	0	0	0	0	3	50

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display. The fact seems to be that this electrical phenomenon,—for as such it must be classed—only becomes apparent under certain conditions of the atmosphere, which are brought about by a rapid withdrawal of heat. A few thermometrical readings, coincident with Auroral observations, may be quoted in proof of this position. For convenience, these are all taken from recent months :—

1870.	January 1.	Temp.	3 p. m. 33° 9;	Midnight	22° 1.	Fall in	9	hours	11° 8
	" 7.	"	1 p. m. 44° 5;	8th, 6 a. m.	17° 2.	"	17	"	27° 3
	" 26.	"	1 a. m. 48° 6;	11, p. m.	35° 9.	"	22	"	12° 7
	" 28.	"	2 p. m. 30° 5;	29th, 7½ a. m.	14° 4.	"	19½	"	16° 1
	" 30.	"	9 p. m. 27° 6;	Midnight	20° 5.	"	3	"	7° 1
	Febr'y 1.	"	2 p. m. 31° 6;	"	19° 5.	"	10	"	12° 1
	" 11.	"	3 p. m. 28° 8;	"	17° 5.	"	9	"	11° 3
	March 1.	"	3½ p. m. 42° 2;	"	32° 5.	"	8½	"	9° 7
	" 5.	"	2½ p. m. 30° 7;	6th, 7½ a. m.	10° 3.	"	17	"	20° 4
	" 19.	"	3 p. m. 35° 7;	11, p. m.	24° 9.	"	8	"	10° 8
	" 20.	"	4½ p. m. 40° 6;	Midnight	29° 2′.	"	7½	"	11° 4
	" 23.	"	3 p. m. 39° 7;	10 p. m.	31° 2.	"	7	"	8° 5
	" 25.	"	3 p. m. 36° 5;	9 p. m.	28° 9.	"	6	"	7° 6
	" 30.	"	2½ p. m. 52° 4;	Midnight	33° 2.	"	9½	"	19° 2
	" 31.	"	2½ p. m. 52° 0;	"	27° 1.	"	9½	"	24° 9

A marked decrease in temperature is noted on each of these fifteen occasions accompanying the Aurora Borealis.

ART. XI. ON THE LAMINARIACEÆ OF THE DOMINION OF CANADA AND ADJACENT PARTS OF BRITISH AMERICA.

BY GEORGE LAWSON, PH. D., LL. D., *Professor of Chemistry and Mineralogy, Dalhousie College and University, Halifax, N. S.*

(*Read January* 10, 1870.)

ALARIA ESCULENTA, Grev.—On rocks about low water mark, extending south to Cape Cod. Found also on the N. W. Coast, according to Harvey. Fucus esculentus of Turner. To this species Harvey refers the Laminaria musæfolia and L. linearis of De la Pylaie's Flora of Newfoundland.

A. PYLAII, Grev.—On rocks near low water mark, Newfoundland, De la Pylaie. Distinguished from the preceding by the form of the pinnæ, which are obovate-spathulate, not linear nor cuneate. Laminaria Pylaii, Bory.

Laminaria Fascia, Ag.—A very small and delicate plant, only a few inches in length, found in Halifax harbour. First on rocks and stones near low water mark, by Professor Harvey, who refers to this species the L. cæspitosa and debilis of Bishop Agardh. Authentic specimens of L. debilis from Professor Kutzing of Nordhausen are exhibited. From its minute size this plant is apt to be overlooked as a young state of other species. It is widely distributed, occurring not only at Halifax and on the New York coast, but also on the Atlantic and Mediterranean shores of Europe, and at the Falkland Islands in the South Atlantic.

L. lorea, Bory.—Shores of Newfoundland, Despreaux, an obscure species, not recently found. Kutzing appears to regard it as a variety of L. saccharina. L. teniata, Post. & Ruprect, according to Agardh.

L. dermatodea, De la Pylaie. Phyllitis dermatodea, Kutz. On rocks at and below low water mark. Newfoundland, Pylaie.

L. saccharina, Lamour. Fucus saccharinus, Linn.—At and below low water mark. Harvey gives it as common on rocky shores from Greenland to New York, and cast up from deeper water on the New Jersey coast, but it is by no means so abundant as L. longicruris. I have a specimen collected by Dr. Rea at Montreal Island.

L. Lamourouxii, Bory, which grows in Boston harbour, is doubtfully distinct from saccharina, and has not been carefully studied.

L. longicruris, Pylaie. Below low water mark, abundant along the shores of Halifax harbour, as at Point Pleasant, and around the wharves at the city. This is the species whose large fronds are so conspicuous, floating in the water around the city wharves, at ebb tide. It abounds from Greenland to Cape Cod. Pylaie notices its occurrence in Newfoundland, where it is no doubt equally common. It occurs likewise in Europe, but is rare there, and has quite a northern range, for it scarcely extends beyond the limits of the Arctic Sea, whence ragged worn fragments are occasionally drifted upon the northern coasts of Scotland and Ireland. Its reported occurrence in the Bahama Islands is possibly a mistake.

Mr. Gossip has informed me of a case in which poisonous effects of a marked character were experienced after eating the common

Laminaria longicruris at Halifax. I have eaten the young plant in small quantity without any inconvenience, but no doubt the poisonous properties will be stronger in the old stems. It is possibly due to the presence of iodine, the compounds of which affect some individuals as irritant poisons.

I have found the long tubular stipes of this species very suitable as gas tubing in fitting up chemical apparatus. It will also be found an excellent insulator for electric cables, if protected from the action of water.

L. TRILAMINATA, Harvey.—Found floating near Narragansett Pier, R. I., by Mr. Olney; is possibly an abnormal form of L. saccharina.

L. DIGITATA, Lam. Fucus digitatus, Linn.—On rocks at and below low water mark, common as far south as Cape Cod. Dr. Harvey's impression that possibly more than one species is confounded under the name digitata, should induce observers to examine the various forms with much care.

AGARUM TURNERI, Post. & Rupr.—The species of Agarum differ notably from Laminaria in the flat frond being pierced throughout with holes, hence the common name "Sea Colander" by which they are known. This species grows below low water mark, and is thrown up in quantity by southern gales at Point Pleasant. It extends from Greenland to Cape Cod, and has likewise been collected on the coast of Russian America, but is unknown on the European shores.

A. PERTUSUM, Mertens. Newfoundland, Pylaie. This plant is distinguished by its less regularly shaped and smaller and fewer perforations. It is probably only an extreme form of A. Turneri, which varies much in these respects.

CHORDA FILUM, Stack.—The frond is of great length, attached by a small disc, and very slender at the base, thickening towards the middle and again attenuating; it is often so long that when taken out of the water it resembles a fishing line. Occurs between tide marks, and extends into deep water; abundant in Bedford Basin.

C. LOMENTARIA, Lyngbye.—Extends from our coasts south to Charleston, S. C.

Kutzing regards it as a remarkable variety of C. filum.

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